THE CRUSHED STONE JOURNAL

Official Publication
The National Crushed Stone Association

In This Issue—

Pre-Mixed Bituminous Surfaces

Business Tries Common-Sense

Costs As a Factor in Management

Housekeeping to Prevent Accidents

JUNE, 1930

WHY HAVE LOSSES

Poor Grading—High Overhead—Troubles

Ask the following stone producers why they are using NIAGARA ROLLER BEARING SCREENS year after year

Solvay Process Company	Jamesville, N. Y.
Solvay Process Company	Syracuse, N. Y.
Rock-Cut Stone Company	Auburn, N. Y.
Rock-Cut Stone Company	Ballina, Madison Co., N. Y.
Rock-Cut Stone Company	Jamesville, N. Y.
Rock-Cut Stone Company	Lacona, N. Y.
Rock-Cut Stone Company	Watertown, N. Y.
Mohawk Limestone Products Company	Mohawk, N. Y.
Mohawk Limestone Products Company	Jordanville, N. Y.
Mohawk Limestone Products Company	Mount Vision, N. Y.
BUFFALO Crushed Stone Company	Buffalo, N. Y.
Federal Crushed Stone Company	Cheektowaga, N. Y.
Genesee Stone Products Company	Stafford, N. Y.
LeRoy Lime and Crushed Stone Company	LeRoy, N. Y.
Ribstone Concrete Products	LeRoy, N. Y.
Dolomite Products Company	Rochester, N. Y.
General Crushed Stone Company	Oaks Corners, N. Y.
General Crushed Stone Company	North LeRoy, N. Y.
General Crushed Stone Company	Glenmills, Penna.
Wagner Quarries	Sandusky, Ohio
Wagner Quarries	Castalia, Ohio
Dolomite, Inc.	Maple Grove, Ohio
Herzog and Sons	Forest, Ohio
Ohio Blue Limestone	Marion, Ohio
National Lime & Stone Co.	Spore, Ohio
National Lime & Stone Co.	Carey, Ohio
National Lime & Stone Co.	Lewisburg, Ohio
National Lime & Stone Co.	Bluffton, Ohio
Belle Center Stone Co.	Belle Center, Ohio
Higgins Stone Company	Bellevue, Ohio
Lake Erie Limestone Company	Youngstown, Ohio
Lake Erie Limestone Company	Lowellville, Ohio
Lake Erie Limestone Company	Hillsville, Pa.
Lima Stone Company	Lima, Ohio
Spencer Stone Company	Spencerville, Ohio
Union Limestone Company	Youngstown, Ohio
Ohio Marble Company	Piqua, Ohio
C. C. Beam	Melvin, Ohio
Rock Products Company	Toledo, Ohio
France Stone Company	Holland, Ohio
France Stone Company	Monroe, Mich.
Swint Stone Company	Fremont, Ohio
J. E. Baker Company	Bainbridge, Lancaster Co., Pa.
J. E. Baker Company	White Hall, Baltimore, Md.
New Castle Lime & Stone Company	New Castle, Pa.
New Castle Lime & Stone Company	Dunbar, Pa.
Lehigh Stone Company	Ormrod, Pa.
Stowe Trap Rock Company	Pottstown, Pa.
Carbon Limestone Company	Hillsville, Pa.
Blue Stone Quarry Company	Gwynedd Valley, Pa.
Whiterock Quarries	Pleasant Gap, Pa.
Connecticut Quarries Company	Rocky Hill, Conn.
New Haven Trap Rock Company	New Haven, Conn.
Edward Balf Company	Hartford, Conn.
John S. Lane and Son	Westfield, Mass.
West Roxbury Trap Rock Company	West Roxbury, Mass.
Old Colony Crushed Stone Company	Quincy, Mass.
Rowe Contracting Company	Malden, Mass.
Simbrico Stone Company	West Roxbury, Mass.
Casper Stolle Quarry & Construction Co.	East St. Louis, Ill.
Consumers Company	Lemont, Ill.
Federal Stone Company	LaGrange, Ill.
Michigan Limestone & Chemical Company	Rogers City, Michigan
Blesanz Stone Company	Winona, Minn.
Meshberger Bros. Stone Company	Berne, Ind.
Hy-Rock Products Company	Marengo, Ind.
Fanwood Stone Crushing & Quarry Co.	Fanwood, N. J.
Samuel Braen	Patterson, N. J.
Orange Quarry Company	West Orange, N. J.
Granite Rock Company	Logan, Calif.
Daniel Contracting Company	San Francisco, Calif.
Deits Hill Development Company	Kansas City, Mo.
Rock Hill Quarries Company	St. Louis, Mo.
Texas Trap Rock Company	San Antonio, Texas
Dittlinger Lime Company	New Braunfels, Texas
James Stone Company	Corsicana, Texas
Franklin Limestone Company	Nashville, Tenn.
Gager Lime Company	Sherwood, Tenn.
John H. Wilson	Honolulu, Hawaii

CANADA

J. A. Bourbonnais	Vaudreuil, Que.
Canada Crushed Stone Corp.	Puslinch, Ont.
Coast Quarries	Vancouver, B. C.
Dufferin Construction Company	Innerkip, Ont.
Gordon Crushed Stone Company	Hagersville, Ont.
Thomas Langton Crushed Stone	Coldwater, Ont.
LaCle A. Desrosiers, Ltd.	Montreal, Que.
Puslinch Quarries, Ltd.	Puslinch, Ont.
Quinn Stone and Ore Company	Ft. William, Ont.
Rigand Granite Products Company	Rigand, Que.
Stone and Son	Ingersoll, Ont.
Standard Lime Company, Ltd.	Joliette, Que.
Walker Bros.	Thorold, Ont.
Warden King Company, Ltd.	Montreal, Que.

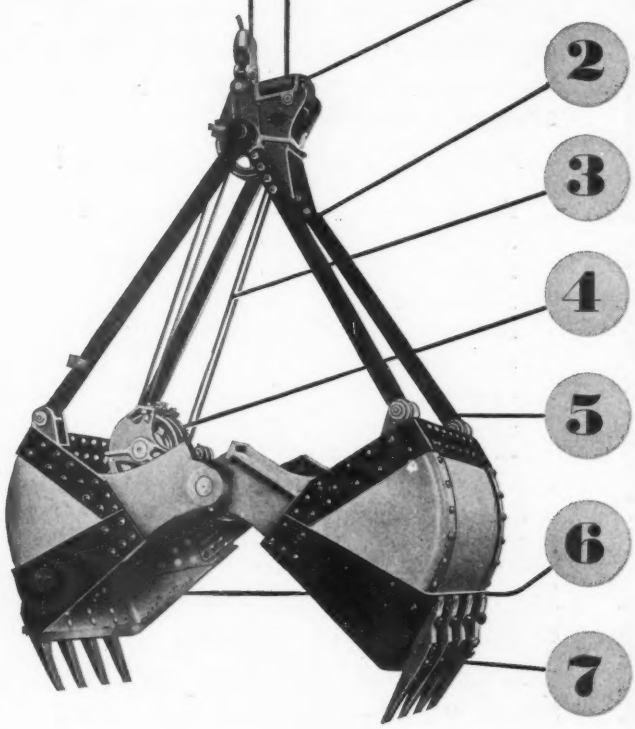
LET US FIGURE YOUR PROBLEMS

NIAGARA CONCRETE MIXER CO.

40 PEARL STREET

BUFFALO, N. Y.

In BLAW-KNOX CLAMSHELL BUCKETS



1 ONE PIECE HEAD BLOCK

Provides complete protection for closing line and avoids excessive cable wear caused by wobbly head construction.

2 FORGED STEEL CORNER BARS

Not hot rolled upset stock, but forged from billet. Will stand abuse.

3 SIMPLE CABLE REEVING

No "S" bends or small guide sheaves--multiplies the life of cable in service.

4 BALL BEARING LEVER ARM SHEAVES

One of the most valuable and economical features in clamshell design. Reduces friction--sand and grit are sealed out--lubrication sealed in.

5 EFFECTIVE LUBRICATION

All moving parts not provided with Ball Bearings are equipped with Alemite Grease Gun connections.

6 HEAVY SCOOP LIPS

Extend entirely around scoop from hinge to hinge. Specially hardened cutting edges which retain their sharpness.

7 ALLOY STEEL TEETH

Made to resist abrasion and wear to the utmost. Attached with special alloy steel bolts insuring rigidity and strength.

These and other differences in Blaw-Knox construction making for longer life and effective usefulness in service are fully described and illustrated in Catalog 1059. Ask for it on the coupon or your business letterhead.

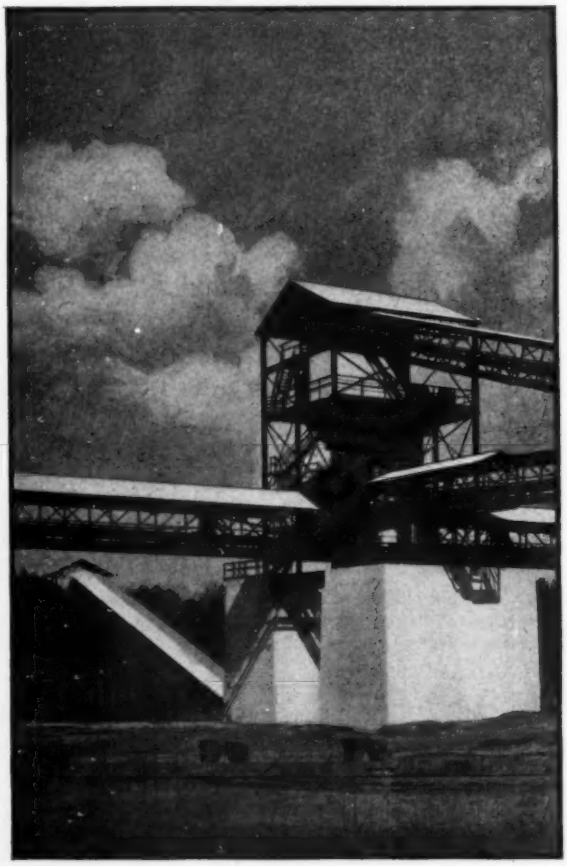
TRADE MARK REG. U.S. PAT. OFFICE
BLAW-KNOX

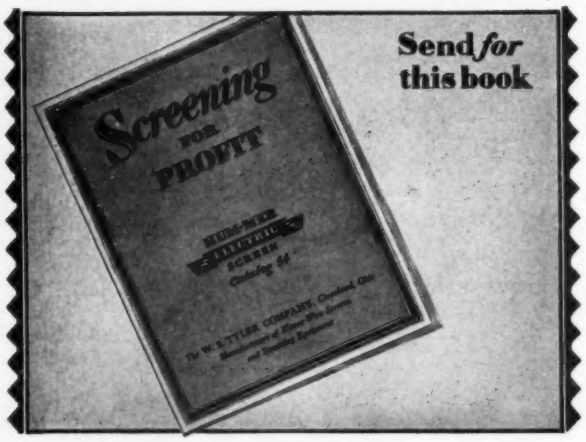
BLAW-KNOX

BLAW-KNOX COMPANY
2053 Farmers Bank Bldg., Pittsburgh, Pa.
Send me Catalog No. 1059 on
BLAW-KNOX DREADNAUGHT BUCKETS

NAME .....
COMPANY .....
STREET .....
CITY ..... STATE .....

DO YOU NEED A LARGER PLANT?





Send *for* this book

WHY increase your plant unless you have to?

You can get bigger production without a bigger plant—simply by installing the Hum-mer screening process.

Thousands of manufacturers have increased their screening or crushing output in this way—and with no increase in power consumption or labor!

Here are a few actual instances!

A stone company	—	50%	increase
A copper	"	— 25%	"
A gravel	"	— 50%	"
A cement	"	— 43%	"
A sand	"	— 50%	"
A fluorspar	"	— 80%	"
A clay	"	—100%	"
A talc	"	— 50%	"
A crushed slate	"	— 50%	"

(Names supplied upon request)

The ability of the Hum-mer to increase capacities *at a lower cost* has been proved on more than 200 different kinds of material.

Learn what Hum-mer capacity, sharp separations, and low cost, dependable operation would mean to your plant.

Send for the book, "Screening for Profit."

The W. S. Tyler Company
Cleveland, Ohio
Manufacturers of Woven Wire Screens and Screening Equipment

HUM-MER *Electric* SCREEN

The CRUSHED STONE JOURNAL

Published by The National Crushed Stone Association

Merchandise Building, 14th and S Sts., Washington, D. C.

Vol. VI No. 6 WASHINGTON, D. C. *June, 1930*

Pre-Mixed Bituminous Surfaces [1]

BY A. T. GOLDBECK,

Director, Bureau of Engineering, National Crushed Stone Association

UNDER the classification, "pre-mixed bituminous surfaces" will be found pavements of a type which show the highest resistance to our present day traffic. It includes surfaces, which, because of their durability are laid on our arteries of heavy traffic, for it has been found by experience that such surfaces are capable of withstanding a tremendous amount of punishment.

For convenience it will be well to classify the various pre-mixed bituminous pavements and for the purpose of the present discussion the following classification will be used. Broadly speaking, there are two general types, the hot mix and the cold mix pavements. The hot mixes include coarse graded bituminous concrete, such as typified by Warrenite-Bitulithic, fine graded bituminous concrete, such as modified Topeka and finally, the sheet asphalt type of pavement with its binder course and asphalt topping. There are also modifications of the standard sheet asphalt type such as the newly developed Westphalt pavement. The cold mixes may be grouped under—

(1) Those which depend upon a volatile liquifier.

(2) Those dependent on an asphalt emulsion.

(3) Those dependent upon comparatively soft bitumens.

As will be seen in the above classification, the field of pre-mixed bituminous mixtures is an extensive one. It seems to be attractive to those of an inventive turn of mind for a great many patents have been granted on various types of bituminous mixtures and thus this field is ever expanding. Obviously, with so many varieties of pavement to discuss it will be impossible to talk about any one of them in as great detail as might be desirable, but an attempt will be made to bring forth the most important facts regarding the several types considered.

[1] Presented before Ohio Crushed Stone Association, May 9, 1930.

Hot Bituminous Mixtures

(a) Coarse Graded Bituminous Concrete

Coarse graded bituminous concrete, such as typified by the Warrenite-Bitulithic pavement has had a very extensive use throughout this country and, in general, when it has been properly supported on an adequate foundation course, it has given excellent service. The Warrenite-Bitulithic type of pavement is one of high density and the specifications for gradation of the mineral aggregate are so drawn as to produce as low a percentage of voids in the aggregate as possible. It is this high density combined with the great mechanical stability obtained through the interlocking and close compaction of the mineral aggregate which has resulted in pavements of this type having high resistance against displacement under the action of traffic.

The aggregate generally extends from 1¼ inch to dust and may include anywhere from 5 to 15 per cent of stone dust passing the No. 200 sieve. The percentage of asphalt is so regulated as to thoroughly coat all of the particles of aggregate and this requires from 5 to 8 per cent of bitumen. This apparently wide variation in percentage of bitumen is made necessary by the fact that in different parts of the country the gradation of the mineral aggregates is apt to vary. The finer the gradation, the greater becomes the surface area of the aggregates to be covered with bitumen and consequently the higher must be the percentage of bitumen used. It is astounding how wide may be the range in surface area of mineral aggregates in a bituminous mix due to their range in gradation.

In the preparation, the mineral aggregates are heated in a dryer and then screened, generally into four different sizes, each size passing into a separate compartment. From these compartments the required amount of aggregate is drawn into a weighing box in such a manner that the required amount of each separate size is used. The aggregate is then dropped into

a twin pug mixer where it is mixed with the required amount of hot bituminous cement. All of the ingredients upon entering the mixer should have a temperature between the limits of 200° and 350°F.

The mixture is then transported to the work and spread upon the foundation by means of hot shovels

Courtesy U. S. Bureau of Public Roads

Sheet Asphalt on a Concrete Base in the Mountains of North Carolina

or forks and is raked as uniformly as possible to such a depth that after rolling the required thickness will be obtained. Before rolling, however, the coarse bituminous mixture is covered with a fine surfacing mixture, generally composed of sand or a combination of sand and stone screenings not larger than ¼ inch in diameter and mixed with from 8 to 12 per cent of bitumen. This mixture is spread at the rate of up to 50 pounds per square yard of pavement and it serves to seal the surface voids in the mixture below. Both layers are rolled together with the use of a 10 to 12 ton roller in whose manipulation the usual precautions for rolling must be exercised. There is no question that this type of pavement, when carefully prepared and laid on a good foundation, is to be considered one of the highest types capable of carrying a large amount of traffic.

A word might be said about the base course suitable for the bituminous concrete pavement in general. This type is laid both on a rolled stone base and on a Portland cement concrete base and at times also on either a bituminous concrete or a bituminous macadam base. A flexible base such as rolled stone or a base of the macadam type naturally must be thicker than the concrete base in order to give equal distribution of the load to the subgrade. It is too often overlooked, however, that no constant relation can be expressed between the thicknesses of these bases because of the great influence which subgrade support has on their respective load carrying capacities. It is conceivable, for instance, that on a well compacted subgrade, perfectly capable in itself of supporting load, the rolled base need be no thicker than the concrete base, while, on the other hand, when the subgrade is of doubtful character the resistance offered against bending by the concrete base permits it to be thinner than the stone base which distributes the load to the underlying subgrade largely by virtue of its thickness. This point too frequently is ignored in making a comparison of respective pavement designs.

(b) Fine Graded Bituminous Concrete (Topeka Mix)

There have been several types of hot mix fine graded bituminous concrete used in this country, the most important of which is the so-called Topeka or Modified Topeka type. The Topeka specification was orginially used in Topeka, Kansas, about 1910 when a decree was signed by city officials and representatives of the Warren Bros. Company making the statement that the pavements constructed under this particular specification did not infringe on the Warren Bros. patent. This specification called for the use of the mineral aggregate all of which passed a ½ inch diameter screen. Because of the finer gradation, the bitumen extended from 7 to 11 per cent, much higher than in the case of the coarse graded bituminous concrete. For heavy traffic this pavement is laid to a thickness of 2 inches, and for lighter traffic 1½ inches thick. The bituminous cements used included a suitable grade of asphalt, of coal tar, or of water-gas-tar.

Modified Topeka

Another form of Topeka specification was the so-called Modified Topeka pavement. This is really a stone-filled sheet asphalt pavement in which the sand portion is required to have a gradation suitable for sheet asphalt pavement construction and the bituminous mortar portion of the mix must have high stability. Generally up to 50 per cent of broken stone is required in the mixture and because of its high density no seal coat is ordinarily required. It would seem that this surfacing is not in line with the present trend in highway construction in which an effort is made to obtain a rather stoney appearing surface which will have high anti-skid properties, even in wet weather. Our present high speed traffic renders it essential that all pavements be made as safe from skidding as possible. The fine grade of bituminous concrete, as typified

by the modified Topeka, is a high grade surfacing and gives excellent results provided care has been taken to obtain stability in the mix. It contains a higher percentage of asphalt than the coarse graded types and it is generally necessary to use a somewhat harder asphalt than in coarse graded mixtures to obtain stability. It is not believed that this type of pavement is used to the same extent as in former years.

The Sheet Asphalt Pavement

The sheet asphalt pavement has been the subject of very elaborate study and research extending over a long period of years. One very notable volume has been written on sheet asphalt by Clifford Richardson and there have been numerous technical contributions at various times by asphalt pavement experts. It would be idle for me to attempt an elaborate discussion of this type of pavement which has required a volume of some 600 pages to cover it in detail.

Perhaps one of the most notable advances in the sheet asphalt pavement in recent years has been the development of a suitable laboratory test for determining the stability of bituminous pavement mixtures. There are several modifications of this laboratory method which, however, depend primarily on the same principle, namely, that the resistance of an asphalt pavement to displacement under traffic depends upon its resistance to shearing forces.

Prevost Hubbard of the Asphalt Institute has done the most extensive work in the development of a stability test. He molds a cylinder of the asphalt mixture under a standard pressure. This cylinder is then placed in a mold having an orifice through which the specimen is forced to extrude under pressure. The greater the stability, the higher the pressure required. This test has been the means of greatly improving asphalt topping mixtures and through its use mixtures of high stability are assured.

It is not generally recognized, however, that extremely high stability may be accompanied by brittleness which may lead to excessive cracking of the pavement, and it would seem that the next step in the laboratory procedure should be to standardize a brittleness test which might be the means of obtaining mixtures of high stability which at the same time will have resistance to cracking.

The Binder Course for Sheet Asphalt

The development of the binder course, which in reality is a hot mix bituminous concrete having a low percentage of bitumen, is a rather interesting story. In the early days of the sheet asphalt pavement the asphalt wearing course was much thicker than it is today. The asphalt pavement laid in 1876 on Pennsylvania Avenue in Washington, D. C., was 2½ inches thick, laid in two courses. The first course which was called a protecting coat was made much richer in asphalt than the wearing surface proper and it was consolidated by the use of light rollers weighing only one-half ton. This first coat was only one-half inch in thickness and its purpose seemed to be merely that of a protecting course so that the natural cement concrete base would be uninjured by the hauling of the final surface mixture. The protecting course contained up to 4 per cent more asphaltic cement than the surface course. This protective coat later became known as a cushion coat. It soon developed that the asphalt pavement constructed in this manner, with a ½ inch cushion coat having a very high percentage of bitumen topped with a wearing course of asphalt, was defective in that it rapidly developed a tendency to waviness under the action of traffic. In those days of steel tired traffic it is to be remembered that high intensities of wheel pressure were developed and these accentuated the movement of the surface under the action of traffic. A change was made in the Washington Specification in 1886 which eliminated the cushion course but for some reason a return was made to the old method of construction, again with disastrous results.

Later on, the excessive thickkness of the asphalt surface was reduced by the use of a cushion course of broken stone coated with coal tar or asphalt. This type of construction was immediately recognized as a big improvement. It was less expensive and showed greater stability under the action of traffic. This course was laid directly on a broken stone foundation and by its use a great saving in cost was made because it filled the voids in the broken stone surface and prevented a loss of the more expensive rich cushion course formerly used. The thickness of the asphalt surfacing was reduced to 1½ inches and economy resulted in the construction of the asphalt pavement.

The binder course was originally made with clean broken stone extending up to 1¼ inch in size combined with a No. 4 coal tar paving cement which was later replaced by asphaltic cement. When Portland cement concrete bases were used, the binder course was continued and is in use today, although in somewhat revised form. Originally the binder contained a comparatively small amount of small stone, resulting in an open binder. This required a relatively small

amount of asphalt. Later on, the aggregate was graded in size to produce the so-called closed binder. This was done in an effort to obtain greater load carrying capacity and greater stability by the use of a dense mix. At the same time, since a closed or compact binder required the use of a greater amount of fine material, with its attendant increased surface area, a higher percentage of asphalt was required with a consequent increase in cost. The binder stone, free from grit, requires about 3 per cent of asphaltic cement when the stone is hard, but the softer limestones require a somewhat higher percentage.

Courtesy U. S. Bureau of Public Roads
Amiesite in Morris County, New Jersey

The asphaltic cement in the binder should be 10 to 20 points softer than that in the surface course because the binder course is more open than the surface course and in its heated condition in hauling to the work more of the volatile material is apt to be lost with a resulting hardening of the asphalt. Moreover, there is less tendency to rupture the bond between the stone when a soft asphalt is used as compared with that containing hard asphalt. It is important that the stone in the binder course be sufficiently hard so that it will not crush under the weight of heavy traffic.

A binder course of asphaltic concrete is known as a close or compact binder and such a course may contain as high as 5 or 6 per cent of asphaltic cement. It is important that not too much fine material be introduced into a compact binder, for it is not desirable that the binder course be free of surface voids. Such voids aid in holding the asphalt topping and prevent it from moving over the binder under the action of traffic.

Westphalt

An interesting modification in fine graded bituminous concrete or sheet asphalt pavement is the so-called Westphalt mixture developed by Mr. W. C. West of the West Process Pavement Company, Inc., Louisville, Kentucky. In this type of pavement either stone screenings or natural sand may be employed, graded approximately like an ordinary sheet asphalt mixture. The asphaltic cement consists of gilsonite which is a hard natural asphaltic pitch mixed with a fluxing material.

The aggregates and asphaltic materials are warmed but not heated very hot and they are mixed together in a pug mixer until a uniform mixture is obtained. Not enough heat is applied to melt the gilsonite, the hard portion of the asphaltic cement, and the mixture when completed and ready to be shipped looks and behaves like finely divided coal, although naturally it is somewhat more sticky. Nevertheless it is very easily handled by the use of a shovel and may be shipped long distances without compacting. When it arrives on the job it is placed in an ordinary concrete batch mixer and is heated by the use of a torch, this time to a temperature which will melt the gilsonite. The gilsonite now combines with the asphaltic flux producing an asphaltic cement of the desired consistency. The kind of flux and its percentage must be carefully controlled at the manufacturing plant in order that the final asphaltic cement resulting from their blending under heat may be of the right quality. After mixing on the job, the Westphalt is spread and rolled like any other sheet asphalt mixture.

The claims made for this type of mixture are that it may be laid by any contractor with simple concrete mixing machinery merely by providing it with a small air compressor for operating the blow torch. The contractor is thus saved the expense of an asphalt plant which otherwise would be necessary. The best results are said to be obtained with the use of stone of good quality. This pavement has attracted some interest in certain sections of the East where plants are being established, and the results obtained will no doubt be watched with considerable interest by paving contractors and highway engineers.

Cold Mix Bituminous Mixtures

Mixtures Requiring a Volatile Liquifier

Perhaps the best known of the pavements requiring a volatile liquifier, because of its long years of very successful use, is the Amiesite pavement invented many years ago by Dr. Joseph Hay Amies. This pavement is a bituminous concrete composed of crushed

stone aggregate, a liquifier, and asphaltic cement. Amiesite is generally manufactured at a central plant located at a stone quarry. In this process the stone is first heated to drive off the moisture which would otherwise cause foaming of the asphaltic cement. Sometimes the stone is dry enough for use as quarried without the necessity of putting it through the drying process. The required amount of stone is weighed, and run into a twin pug mixer and with it is introduced from 0.4 to 1 per cent of so-called liquifier which generally consists of petroleum naphtha, or at times of kerosene or even heavier material. The virtues of these respective liquifiers will be touched on later.

After thorough mixing of the stone with the liquifier, which is evident by the uniformly shiny appearance of the stone, the previously heated asphaltic cement is added, together with approximately 1 per cent of hydrated lime and the mixing is continued until the lime disappears and a thorough, uniform mixture is obtained. The asphaltic cement is quite soft as compared with that used in hot mixture bituminous concretes. It has a penetration generally of 100 in the penetration apparatus. The temperature of the stone during the mixing period should be somewhere between 60 and 125°F. while the asphaltic cement is run in at a range of 250 to 325°F.

In the preparation of this mixture an effort is not made to obtain a dense, compact material, but rather one which will be open and which will have a considerable percentage of voids, for it must be remembered that a liquifier has been added which must later evaporate in order that the pavement may have maximum stability. Were the mixture to be made having high density, the liquifier would be retained and lack of stability might result due to the continued excessive softness of the asphaltic cement.

An effort is made to produce a film of asphaltic cement on the surfaces of the stones which will be of considerable thickness for it is felt that the life of the pavement is thereby greatly prolonged. To accomplish this result a small percentage of so-called mineral filler or stone grit is added in the mixing operation consisting of particles all of which pass an 8 mesh sieve and 50 per cent of which are retained on a No. 50 sieve. Up to 6 per cent of this material is added to the coarse mixture used in the bottom layer and 8 per cent in the fine mixture used in the top layer of the pavement. It is important that only enough mineral filler be introduced to increase the volume of the asphaltic film but not enough to fill the voids in the stone.

The small percentage of hydrated lime which is used is not added as a filler, such as employed in sheet asphalt pavement, but rather because of its action on the asphaltic cement. It seems to aid the asphaltic cement in coating the stone and also there seems to be some evidence that it aids in the adhesion of the asphalt to the aggregate.

The coating of the stone with liquifier previous to the addition of the asphaltic cement seems to be of decided advantage for in the first place it tends to prepare the stone surfaces for more intimate contact with the bituminous cement through the removal of any dust coating which might be present and, moreover, the absorption which takes place and the thinning down of the asphalt immediately adjacent to the stone probably adds to the adhesion of the asphaltic cement.

With regard to the type of liquifier used there is some question in the minds of engineers. Some engineers are most decidedly opposed to the use of any liquifier which is less volatile than naphtha, for they claim that any liquifier heavier than this will be removed by evaporation too slowly and an unstable pavement might result under the action of traffic during the initial period before the volatile material has disappeared. It has been the custom at some plants to employ a less volatile liquifier during cool weather in order to make the Amiesite easier to handle prior to construction. During cool weather less rapid evaporation takes place than in hot weather and consequently the liquifier remains in the pavement a much longer time than in the hot summer months. Some plants have even used a material for liquifying as heavy as fuel oil, primarily with the object of making their mixtures easier to handle. Just what are the merits of these respective liquifiers is somewhat difficult to say, but certainly the theory upon which this pavement was designed would seem to require the use of a material which is at least volatile enough to disappear from the pavement before it is subjected to very much traffic.

The Amiesite type of pavement is generally laid in two courses having a total compacted thickness of 2 inches. The mixture of these respective courses called for by the Amiesite Company is as follows:

Material	Bottom Layer	Surface Layer
Broken Rock ..	86.0% to 92.0%	83.0% to 90.0%
Liquifier	.4 to 1.0	.4 to 1.0
Asphaltic cement	4.0 to 6.0	5.0 to 7.0
Hydrated Lime	.5 to 1.0	.5 to 1.0
Mineral Filler.	0.0 to 6.0	0.0 to 8.0

For the bottom course the stone should have a maximum size of 1½ to 2 inches and extend down to ⅜ inch; not more than 15 per cent should be retained on the 1½ inch laboratory screen. The mixture used in the top course consists of stone extending from ⅝ inch down to the 8 mesh laboratory screen. In laying Amiesite pavement the bottom layer is deposited outside of the area where it is intended for use and it is then spread uniformly to a thickness which when compacted and including the compacted top layer will create a pavement having a thickness of 2 inches.

Courtesy U. S. Bureau of Public Roads

Bituminous Concrete on a Concrete Base, west of Nashville, Tennessee

The bottom course should be spread in a loose layer to something over 2 inches in thickness. After spreading uniformly it is rolled thoroughly with a 10-ton roller. The top course which is built to follow immediately after laying and rolling the bottom course and preferably not more than 300 feet back of the bottom course is laid to a loose depth of one inch. Approximately 73 pounds of mixture per square yard are required. This top course is thoroughly rolled, after which cover material consisting of clean, dry, coarse sand or screenings smaller than ¼ inch in diameter is spread in a thin layer over the entire surface and thoroughly rolled and is sometimes coated with a thin asphaltic cement.

An innovation has recently been made in the Amiesite pavement the results of which should be watched with considerable interest. It consists in the addition of a small percentage, little in excess of one per cent, of rubber latex to the asphaltic cement. The character of the asphaltic cement is thereby altered. It becomes more adhesive and more ductile, and it is believed that a certain amount of elasticity will be added and that a general improvement will result. Amiesite mixture stored in bulk and covered with canvas to retard the evaporation of the volatile material will remain in a sufficiently workable condition for several months. The desirable appearance of the Amiesite surface is what might be termed stoney or gritty and to accomplish this the final cover of sand or stone screenings should be very thin so that the stones in the surfacing mixture will not be thoroughly covered but will merely have their surface voids closed.

Tarvia-lithic

A material somewhat similar to Amiesite in its general characteristics and in the general method of construction is the pavement recently promoted by the Barrett Company under the trade name of Tarvia-lithic. Here, tar is used as the binder instead of asphalt and there are other deviations in the mixture. The Tarvia-lithic mixture is made with three sizes of good quality stone— 1½ inch or large size for black base construction, foundations and wearing courses, ¾ inch for binder course, patching and light wearing courses and the stone chips or fine size is used for spreading over the coarser mixtures as a void filling material, thus producing a dense, tough pavement.

The Tarvia-lithic pavement is laid cold and it consists of a bottom or binder course usually of coarse or intermediate size mixture and a top course of fine mixture. It is advocated that for a finished depth of 2½ to 3 inches the coarse size material be used and that for 2 to 2½ inches the intermediate mixture be used in the bottom course. The top course is made of the fine mixture laid in just sufficient thickness to cover the bottom course and this generally requires not more than 1 inch of loose, fine mixture.

The rock for the coarse mixture extends from 2½ to 1½ inches in size, that for the intermediate mixture between 1½ and ½ inch and for the fine mixture crushed rock between ⅝ inch and the No. 10 mesh sieve is used. To expedite the handling of the mixture it is suggested that the inside of truck bodies, that the tools, and roller wheels be treated sparingly with either soapy water or a mixture of water with a small amount of lubricating oil.

The rolling of the bottom course must be regulated according to the condition of the mixture. Time should be allowed for the bitumen to harden sufficiently in hot weather so that after it is compacted by rolling it will have enough stability. Low spots must be filled in with additional material and the rolling continued until the surface presents a uniform appearance

and has the proper crown and grade. When the top course is spread, the foundation course must be clean and dry and if it has become wet, time must be allowed for the moisture to evaporate. The top course, or fine Tarvia-lithic mixture, is spread to a loose depth of one inch and rolled with a heavy roller in the usual manner. Sometimes a sealing mixture made of dry sand and Tarvia B is used to thoroughly fill the voids in the top surface. The Tarvia-lithic surface like the Amiesite surface must be laid on a well compacted, well prepared foundation whose inequalities have been eliminated, either by patching methods or by scarifying, the application of additional aggregate and re-rolling.

Other companies, such for instance as the American Tar Products Company, produce tar suitable for making either hot or cold mix bituminous concretes used either for patching or for re-surfacing. Such mixtures when made for cold application are of the open type and depend for their solidification on the volatilization of the lighter oils.

Cut-Back Binders

Cut-back or cold patching material is made with both asphalt and tar. In the case of asphalt it consists of asphaltic cement dissolved in petroleum naphtha and cut-back tars are merely heavy tars dissolved in the lighter tar oils. Apparently a great many different grades of cut-back materials have to be made by the manufacturers for different purposes. It is said that one manufacturer produces 16 different grades of cut-back material in order to satisfy the market demand. The success of a cut-back mixture depends upon several items.

In the first place the cut-back asphalt is very soft when it is mixed with the coarse aggregate and in this condition it cannot act as a binder or asphaltic cement. Consequently, it is essential that the solvent evaporate in order that the cut-back material might thicken and leave a residual asphalt or tar of the proper consistency for cementing the stone together and yet not become so hard that it is excessively brittle. Obviously, a dense mixture cannot be successfully used with cut-back material because there would be no opportunity for the solvent to evaporate and allow the mixture to harden. Consequently the aggregate used must be more or less one size stone or at least the mixture must contain open voids after compaction.

The question of the proper consistency of the cement after evaporation is a matter which must be looked after by the the manufacturer but this may be readily specified and determined in the laboratory. The mixing of cold-patch mixture may be done properly either by hand or by machine. If mixed by hand, it is done in small batches on a mixing board or other smooth surface. Just sufficient cold patch is used to thoroughly coat the stone after thorough mixing. A concrete batch mixer is suitable for preparing mixtures of this type.

After mixing, the cold patch material should be piled together and placed under a cover and allowed to cure for several days. The object of the curing is to permit the volatile solvent to evaporate to some extent which permits the asphaltic or tar cement to stiffen so that when the mixture is laid and compacted it will have sufficient stability to withstand traffic. If laid immediately after mixing, there will be the strong possibility of the mixture waving and shoving under wheel loads. Moreover, it would not be waterproof until the bituminous cement had been allowed to harden somewhat. Cold patching material is more expensive than asphaltic or tar cement because of the presence of the volatile solvent. However, this additional expense is offset to a very considerable extent by the convenience with which cold patch mixtures may be used. Cold patch cement is also valuable for penetration work and has very much better penetrating properties than hot asphaltic cement.

Asphalt Emulsions

An emulsion of any two materials consists of a mixture of these materials in the form of minute globules intimately intermingled but preserving their respective identities. Asphalt may be emulsified with water by the use of soapy or clayey materials and by the application of violent agitation. An Asphalt emulsion then consists of an intimate mixture of minute globules of water and asphalt together with a small percentage of an agent such as clay or oleic acid introduced to aid emulsification. Some emulsions contain 70 per cent of asphalt cement and others only as much as 50 per cent, and the remaining material is largely water. Premixed pavements with emulsified asphalts were made in the early days under the Van Westrum patents. In 1908 the Westrumite Company at Chicago laid pavements of this type and since that time a number of very successful pavements have been laid with emulsified asphalt both in this country and abroad.

Obviously the emulsion cannot act as a binder as long as it remains in an emulsified condition and it is necessary that the emulsion "break" that is, separate into asphalt and water before the asphalt can become

useful as a cementing agent. In the old days there was always some uncertainty as to the time at which the breaking down of the emulsion would occur and should it happen that a heavy rain occurred before the breaking of the emulsion the newly laid surfacing would probably be destroyed.

The breaking of some emulsions depends upon the evaporation of a portion of the water but there are various ways of causing an asphalt emulsion to break and apparently the manufacturers have better control over emulsions nowadays. At least one of the emulsion manufacturers is now producing an emulsion which does not precipitate or break due to freezing. The ordinary emulsion is destroyed when it is frozen.

Recently two new emulsions have been introduced extensively into this country under the trade names of Colas and Bitumuls. Both of these materials are said to have been used extensively abroad and apparently with very good success. It is said that there are several cities in Germany that lay all of their pavements by mixing a stone aggregate with an asphalt emulsion. The mixing is done in a standard asphalt plant. In addition, the Headley Emulsified Products Company and The Barber Asphalt Company have been steadily improving their emulsions, and no doubt there are still others of good quality being marketed.

Emulsions are used very largely for penetration work and the following are some of the advantages claimed by the manufacturers for emulsified asphalt which are not possible when the same asphalt is applied hot.

1. Because the emulsion can be handled and applied cold and involves the use of simple, inexpensive equipment.
2. Due to extreme fluidity an emulsified asphalt will penetrate any reasonable depth of unbound road metal and will uniformly coat the particles with a thin coating.
3. Emulsified asphalt does not chill or coagulate upon contact with cold road metal as does hot asphalt and can therefore be used in any except freezing weather. The fluidity of the material also prevents the use of excessive amounts; the surplus beyond that required to coat the stone flows to the subgrade or escapes at the edge of the road. The asphalt remaining while sufficient to bind the road metal does not provide an excess which later results in bleeding or displacement in the pavement.
4. These fluid emulsions break readily in damp weather and construction may therefore proceed under weather conditions which would prevent the use of hot asphalt. Moisture on the road metal does not prevent satisfactory construction. In fact, much work has been built in damp or even mildly rainy weather. The direct effect of this is to lengthen the construction season.
5. Emulsified asphalt is used extensively for patching pavement and is particularly suitable for this work because no heating or preparation is required and because it can be used on wet pavements and under otherwise unfavorable climatic conditions.

It is doubted by some asphalt experts as to whether the pre-mixed asphalt emulsion pavements will be able to compete with pavements of the same class using less expensive binding materials. Nevertheless emulsions seem to possess merit and their progress will make interesting watching.

Rock Asphalt

Rock asphalt seems to have been the first asphalt pavement ever used and originally the best practice called for the heating of this material to facilitate its laying. Nevertheless in numerous instances asphaltic rock was merely broken and laid cold and allowed to be ironed out and consolidated under the action of the traffic. The earliest record of the use of asphalt in this country seems to be in California. In 1868 a cold rock asphalt pavement was laid with asphalt from the Santa Cruz asphalt mines. Here, the material was merely spread over the street, tamped into place and subjected immediately to traffic. Kentucky rock asphalt is perhaps the best known rock asphalt in the eastern part of the United States and it is invariably laid cold. It consists of a very friable quartz sandstone containing about 7 per cent of very soft bitumen which has a penetration of 150 to 200 with a standard penetration needle. When it is recalled that asphalt for sheet asphalt work may ordinarily have a penetration of only 50 to 60 it will be realized how very soft is the asphalt in Kentucky rock.

The ease of handling Kentucky rock asphalt while cold is due to the very low percentage of bitumen (7 per cent as compared to 9 to 12 per cent in sheet asphalt) and to its excessive softness. Kentucky rock asphalt has practically no bond until the grains are compressed together, when it attains sufficient stability to support wide tired vehicles. In former days it was cut and rutted badly under the action of steel tired traffic but modern traffic exerts a lesser pressure

in pounds per square inch, yet it is sufficient to compress a rock asphalt surfacing so that it holds together remarkably well.

Attempts have been made to make artificial rock asphalt and most of these have been unsuccessful. The stability of rock asphalt seems to be due largely to the extreme angularity and high adhesion of the grains to the bitumen. It seems to be essential that a Kentucky rock asphalt surfacing receive a sufficient degree of compression and attain proper density before cold weather sets in for otherwise high absorption and subsequent freezing of the surface may be very detrimental.

Other Pavement Types

There are several other types of pavements which are well worth mentioning because of their novelty and possible usefulness in the future. One of these is the so-called Colprovia. It was patented by an Englishman and has been laid abroad for the past 6 years. Several samples were laid in this country some three years ago. It has been used in increasing amounts in the United States and Canada. The method of manufacture is as follows:

The aggregate is weighed into the mixer which may be either a pug mill or a rotary mixer and there it is mixed with a heavy oil until all of the stones are thoroughly coated. After this a powdered hard asphalt is thrown in and becomes uniformly distributed throughout the mass. Then a limestone or other suitable filler is added. After thorough mixing the mixture is ready for laying or it can be stored for future use. The laying operation is much like that of hot mix but is said to handle and rake easier. For the first day or so a few of the stones kick out under traffic but the surface soon hardens and resembles a hot mix bituminous concrete pavement.

In mixing it is preferable that the stone be dry and cold for otherwise there is danger of prematurely blending the asphalt and the flux which makes the mixture too stiff to rake easily. The asphalt used generally has a penetration of about 4 at 77°F. It is so hard that it can be pulverized in summer temperatures. The flux oil must be of such a nature that it will slowly blend with the hard asphalt and finally form an asphaltic cement.

The theory upon which the pavement is based is that the blending of the flux oil and hard asphalt will take place slowly so that finally an asphaltic cement of the proper consistency will result. The fact that the stiffening of the asphalt does not take place until after the pavement is laid makes for the easy handling of the mixture. This pavement perhaps has not been laid a sufficiently great length of time to permit engineers to form any judgment of its value but it is mentioned with the idea that possibly it may develop to be a valuable type of asphalt pavement.

Courtesy U. S. Bureau of Public Roads

Bituminous Concrete on the Columbia River Highway in Oregon

Macasphalt

Still another type of pavement of interest known as the Macasphalt pavement is manufactured as follows: An asphalt cement is first made by blending together the powdered, hard, natural asphalt with a petroleum flux at a temperature of not in excess of 230°F. The proportions are so regulated as to give an asphalt of about 200 penetration. The aggregate is about the same as that used in the hot mix bituminous pavement. It is first heated and dried and when the aggregate has cooled to 150°F. it is mixed with the asphaltic cement at a temperature not in excess of 250°F. and is then ready for laying. If it is desired to store it for future use, several quarts of water are thrown in the mixer before the batch is completed. This seems to prevent a too rapid solidification of the material. Sometimes water is added even to mixtures to be laid immediately, for it is said that the water fluffs up the material and makes for easier laying and raking. Although the asphaltic cement has a penetration of 200 it is said that this pavement resists traffic very well. It is claimed that this particular cement possesses virtue because of the mixture of the hard natural asphalt with the particular flux used which gives an asphaltic cement which it is claimed cannot be duplicated with

oil asphalt. It is also the theory that the heating of asphalt as high as 300°F. destroys its cementing properties and consequently in this method the temperature is not allowed to exceed 250°F. Here again, this pavement is of interest merely as a possibility for the future.

Recent Developments

There are some recent developments which should aid in the increasing use of pre-mixed types of bituminous surfaces. It is a well known fact that the average traveller of the highways is mainly interested in their smoothness. He notes whether the pavement is white or black but his principal concern is with the character of the surface. He wants it smooth and he wants it to be non-slippery. An important development has been taking place which I understand was initiated in the state of California in the spreading and finishing of pre-mixed bituminous pavements, described in May, 1930, issue of the *Journal*. I refer to the use of a finishing machine operated on side forms such as used for concrete construction. It should go without saying that any device which will produce a homogeneous smooth surface through the more uniform spreading of the material, most certainly must be an improvement over the old hand raking methods and must add greatly to the smooth riding qualities of the bituminous surface. I would advise engineers to look thoroughly into the practicability of using finishing machines in the finishing of their bituminous concrete surfaces of whatever type used.

There is still another idea in the offing and which is still in process of development. It consists of a simple machine for making bituminous emulsions on the job as they are needed, combined with a device for mixing the aggregate and emulsion together. The emulsion as made is emptied into a hopper placed along side of the railroad car containing the crushed stone aggregate. The aggregate is conveyed automatically to the hopper from which it is scraped by still another conveyor which carries it to the waiting truck. The excess emulsion with which the stone is now coated drains back into the hopper. The emulsion coated stone is then ready for laying.

If a dipping process produces a thorough enough coating on the stone as is claimed, this operation would seem to present several economies in the production of premixed material using emulsion. It would also seem that if the dipping process is suitable for emulsion it should also be suitable for the cut-back tars and asphalts.

There has been a rapid advance in bituminous pavement construction over the past several years and, moreover, the various highway building agencies all over the country seem to be developing a very much greater interest in bituminous types than ever before. It is highly important that our secondary road systems be improved rapidly and the highway departments very properly recognize in bituminous mixtures a comparatively inexpensive method of gaining mileage. They also recognize in them an ideal material for the maintenance of almost any type of road and it would seem that bituminous mixtures have before them a very bright future.

Experimental Highway To Be Constructed To Test Types of Low-Cost Surfacing

Construction of an experimental highway, with twenty half-mile lengths of various low-cost oil-treated surfaces, has recently been started under the joint supervision of the U. S. Bureau of Public Roads and the California Division of Highways. The same two organizations will maintain the 10-mile stretch for three years, keeping account of the construction and maintenance cost as well as the service obtained, with a view to obtaining accurate comparative cost data. Some sections will be sealed before winter and others will be sealed later, depending on their action under weather and traffic conditions. The test road is located in the mountains near the Nevada line, where the climate includes both severe winter conditions and warm, dry summers. Results of the test, should be of value not only to California but also to other states that look to the Bureau of Public Roads for this type of information.—*Engineering News-Record, May* 15, 1930.

The Association Movement

"In the coming years it will be increasingly realized that the safety and progress of business depends fundamentally upon alert, aggressive and intelligent business management of the individual concern and secondly, upon progressive and informed co-operation within each industry through the trade association. The development of the trade association movement in American industry in recent years is the most substantial promise of future progress, because it conserves individual initiative within the industry, and provides greater flexibility of adjustment to changing conditions for the industry as a whole."

VIRGIL JORDAN,
Vice-President, McGraw-Hill Publishing Co.
—From "Low Bidder," December, 1929

Business Tries Common-Sense[1]

By JULIUS KLEIN
Assistant Secretary of the U. S. Department of Commerce

CAUSTIC critics of our so-called "commercial civilization" are particularly fond of deriding the "excessive gregariousness" of the American business man. Upon this propensity of his they pour the choicest vials of their scorn. From their villas on the Riviera, or from behind the breastworks of heaped-up saucers in the cafés of the Latin Quarter, the expatriates who profess to despise America and all its works let fly the barbed (and sometimes poisoned) arrows of exasperated satire at the tendency of American business men to get together and "whoop it up" for Dear Old This-or-That.

For some inexplicable reason—through some queer distortion or quirk of personality—these mournful critics seem to think of such gregariousness as something vulgar. They conceive it as an affair merely of vapid vaporing, pointless parading, and blatant backslapping. They evidently feel that it is an occasion for nothing but amusement, being productive of no solid good.

I need hardly register my own conviction that such a feeling is extremely remote from the truth. Far from being ludicrous or futile, the intense gregariousness of the American business men is one of their most praiseworthy characteristics. It is one of the greatest contributions to good-will, better morale, and material betterment.

Indeed it is one of the elements of American business strength which competent European observers look upon quite frankly with envy. The excessive individualism, the suspicion, the almost medieval cloistered secrecy prevalent in many parts of Old World business life are the despair of its more ambitious leaders. Again and again I have had foreign governmental officials lament loudly to me over their inability to secure from their industries and trades anything remotely resembling the splendidly *organized* collaboration which is extended to our Governmental trade-promotive agencies by American business. Whatever success the Department of Commerce has attained in recent years is certainly due in large part to the fact that it can command the most effective group collaboration instead of wallowing futilely in a morass of tens of thousands of individual business contacts. Industrial and commercial leaders throughout the world are quite outspoken in their longing for "something comparable to American business teamwork."

In very great measure, the startling commercial advance of the United States in recent years is directly attributable to organizations such as Rotary, the chamber of commerce, and the trade association.

The first two of these have brought about indisputable benefits that are recognized readily enough by any student of the contemporary business scene, but I think that perhaps the merits and meaning of the trade association are not quite so widely realized.

Trade Association Has Real Significance

The significance of the American trade association is profound. Its ideal of coöperation is incalculably important. It represents a notable departure from the practices of the American past and from the attitude that still prevails in many sections of European business.

The old notion—the notion that has been largely banished by the trade association—was that of "every man for himself" (and the rest of that foolish adage). A misunderstanding of the spirit of competition impelled many business enterprises to stand more or less alone, suspiciously maintaining what they would have called their "independence of action." Each firm was self-centered and willing to fight only for its own interests. Trade practices that had been distinctively successful must it was felt, be sedulously guarded. Thus secretiveness prevailed. Jealousy reigned. And rancorous rivalries, all too frequently, arose.

Under conditions such as those, business interests that actually had much in common (had they only appreciated that fact) worked often at cross-purposes. Any sudden emergency in the business life of the Nation—any threatened danger—was, for that reason, potentially more perilous than it could possibly be to-day.

The unwisdom of such selfish exclusiveness became apparent to the vast majority of American business men. They came to see that in many vital respects their interests were identical with those of all the other persons engaged in their particular industry, activity,

[1] From the April, 1930 issue of the *Rotarian*

or trade. They became keenly aware of the broad general influences that affected all similar enterprises —of the pressing problems that could be combated and solved only through the medium of coöperative effort. It was through a realization of these things that trade associations were created—and have risen, with such vigor, to power and prestige.

Mutual Helpfulness

"Mutual helpfulness" is the ideal of the trade association. Let us consider, for a moment, the implications of that phrase. Many social commentators, in viewing America to-day, deplore the passing of the old neighborliness between individuals and families—the old generous eagerness to extend help and supply lacks. The reason for this is not far to seek. There is no longer such urgent necessity for that admirable attitude of former days. Modern facilities, modern service, the growth of the apparatus of civilization, have enabled people to dispense with much of the old interchange of assistance between small groups.

But the spirit has not been extinguished. The mood has not been lost. What has happened is this: *Mutual helpfulness has been lifted to higher levels.* It has been inexpressibly broadened. It has been made predominantly practical. It has become a major, militant factor in the entire economic organism of the United States.

Sane solidarity, reciprocal assistance—these are the powerful motivating forces of the modern American trade association. The old-time crabbed, suspicious merchant or manufacturer who waged lone-handed guerilla warfare would doubtless be overcome with amazement if he could witness the candid interchange of opinion—even to ledger experience—the manifest willingness to submerge petty self-interest in the common welfare, and all the other qualities that distinguish the deliberations of a trade association.

The titanic developments of modern business have made these things indispensable. The requirements are too exigent now—the problems are too far-reaching and too intricate—to be grappled with effectively by any single firm, however intrepid or self-confident it may be. Mass action is imperative—and mass assaults can move mountains.

Trade Associations Prove Invaluable to Government

Such mass-action as the trade associations make possible has proved invaluable in movements like that initiated last fall by President Hoover's conference for economic stimulation and business betterment.

The Department of Commerce, I am sure, would have been quite unable to accomplish as much as it has in the furtherance of export trade and the systemization of domestic business had it not been able to deal with trade associations. The Department works in coöperation with more than sixty committees representing such associations. Thus we enjoy the inestimable advantage of treating with a unified, responsible body, authorized and competent to voice the needs and express the viewpoints of an industry as a whole.

If it were necessary to thresh out every question with all the individual units in an industry, the task would be, in most cases, gigantic and interminable. The trade association provides a "leverage"—a facile implement—which enables both the industry and the Department to get practical results quickly.

Research Made Possible

The strength that springs from union is nowhere more apparent than in the research activities of the trade associations. Technical and market research, in these days, is apt to be expensive—often so extremely costly that a single firm could not dream of defraying the full expense of procuring the vital facts it needs. But the pooling of such expense by dozens or hundreds of firms (the results to be made available to all alike) puts a totally different complexion on the matter.

And this is precisely what is done through most trade associations. Coöperative research by such associations takes a variety of forms. There is, for instance, the collection of statistics—figures which give the industry a clear conception of its position.

Then there is research of a strictly scientific character—discovering new principles, new applications of natural laws, through which an entire industry may reduce costs, increase efficiency, strengthen sales-appeal, or develop new uses for its products. If you were to go through our department's wonderful scientific establishment, the Bureau of Standards, you would find nearly four-score "research associates" — each employed by a trade association or by a specialized scientific or technical group but accorded full use of the facilities of the Bureau to initiate and conduct research. Nor is this all. In a true trade association each industrial unit is in itself a laboratory, the achievements of which are spread to the entire industry through the medium of the association.

The success of that splendid movement which we know as "simplified practice"—meaning the collective

effort of an industry to reduce waste in the production and distribution of its products, through eliminating unnecessary varieties in sizes, dimensions, grades, or qualities—has been made possible only by trade associations. Such extensive revisions of old-established practices could be brought about only through concerted, well-directed drives.

Elimination of Trade Abuses

Most trade associations strive earnestly to do away with trade abuses. Such abuses, of course, are many and insidious. Let us look briefly at a few of the more obvious ones. Salesmen may misrepresent merchandise, or promise things that their employers are unable to fulfill. They may assure a firm that a line will be exclusive—and then sell to competitors. Driven by a fierce desire to fill their order-books, they may urge retailers to overbuy. Shipping instructions may be disregarded. Merchandise may be delivered that fails to conform to samples or specifications, or that is soiled or imperfect. On the other hand, one often finds unwarranted cancellations of orders, unreasonable demands for concessions, or unjust returns of goods.

Surely there is ample room for vigorous activity on the part of trade associations in combating such irritating, costly impediments and chicaneries as these. And, as a matter of fact, we find the associations wielding a sharp scimitar to lay low such evil growths wherever they are susceptible of legitimate attack.

The codes of ethics or business principles to which various trade associations are pledged assuredly make interesting reading. I find, for example, a pledge "to maintain proper factory conditions and to consider and conserve the physical and moral welfare of the employees." I find an expression of the conviction that "service is the basis of all progress." Again, there are declarations in favor of "full and frank publicity," of "arbitration," of "high business standards through the education of members." Conversely, I find the resolution to "avoid scrupulously all overstatements or misrepresentations." Most significant of all, perhaps, is the determination to "make no pretense of alleged 'trade secrets' or the possession of other mysterious advantages over competitors," and, in the case of another association, the expressed belief "that it should be a duty and a pleasure to impart to less-experienced competitors any knowledge which may be of help to them, as long as there is reason to believe that the information will be fairly used." The mere formulation of such standards justifies the existence of trade associations; a conscientious adherence to them means nothing less than a new era in the commercial world.

Cooperative Advertising

Remarkable results have been obtained through coöperative advertising by trade associations. It seems likely that trade associations spend each year more than $10,000,000 on commercial advertising. Some extraordinarily profitable slogans and ideas have been popularized in this manner. And, through such activity, the industry itself has often become much more keenly "market-minded"; it has been made alive to the possibilities of creating business rather than merely "swapping customers."

We must not overlook the "protective" or "restorative" value of such advertising. Some time ago, just after we had witnessed such extensive publicity on pure-food legislation, the canners of food products were faced with the problem of restoring public confidence in canned goods. The findings of extensive laboratory research formed the basis of a successful advertising appeal. And, again, the coffee roasters found it necessary to conduct an educational campaign on the healthful effects of coffee used in moderation. Trade associations can do that sort of thing most admirably.

Trade Relations Committees Necessary

We must bear in mind that, in the vast majority of instances, violations of commercial ethics take place in the dealings between manufacturers and wholesalers or between wholesalers and retailers. For this reason joint trade-relations committees are necessary in order that the disputes and unethical practices which occur between different branches of the same trade may be studied collectively and methods may be devised for their elimination.

We must never forget that there are certain things which trade associations cannot legally do. I will merely cite the opinion of one who has studied the situation closely and who says that it seems clear, from the decisions of the United States Supreme Court, that combinations or agreements are unlawful if they directly fix uniform prices for the products of an industry in interstate commerce (without regard to the reasonableness or unreasonableness of the prices fixed); if they excessively limit or regulate the volume of production of such an industry; or if their

(*Continued on page* 26)

Costs As a Factor in Management

By H. B. BLANKE
Business Analyst and Cost Consultant

TWO men, both of whom understand their own cost accounting, may be unintelligible to each other through not using the same term meanings, not including the same costs in similar accounts or not computing their overheads and ratios in the same manner. With this in mind, let us determine the factors included, interpret these factors for the purpose at hand and in a general way show the relationship of cost accounting to the executive and his organization.

"Cost as a factor in management" suggests four factors to be included within the scope of the subject:

1. Management— "the collective body of those who manage or direct." Or it may be defined as "the control of business by executive officers."

2. The Manager or Executive. May I suggest a Sixteenth Century description of a statesman, given by Fenelon, as a definition of a business executive, "the real statesman, while doing nothing himself, causes everything to be done, he contrives, he invents, he foresees the future; he reflects on what is past; he distributes and proportions things; he makes early preparations; he incessantly arms himself to struggle against fortune as a swimmer against a rapid stream of water; he leaves nothing to chance."

3. The Functions of Business. James H. Bliss in his book, "Financial and Operating Ratios in Management," states, "The manufacturing and merchandising businesses consist of three general fuctions; (a) Merchandising—the buying and selling functions; (b) Operating—the performance of manufacturing and distributing services; (c) Financial—the responsibility for the economical and efficient use of capital in the business.

4. Cost Accounting and Cost Finding. W. B. Lawrence in his book, "Cost Accounting" states, "Cost accounting is merely an application of accounting principles in greater detail than is generally found in general accounting." Nicholas T. Ficker in the preface of his book "Industrial Cost Finding." says "the ultimate objective of all cost finding is executive control by means of which all forms of waste may be eliminated."

Cost Accounting and the Executive

The executive is not, as a rule, interested in the technique of Cost Accounting. If he is interested at all, it is for the information it develops and what it costs to get it. The information must be concise, reliable, pertinent, and quickly understandable. Business conditions in competitive industries do not remain fixed; competitors are constantly changing tactics; demand for certain lines fluctuates; recurring periods of general or departmental prosperity and depression are continual; these things requiring continual action for adjustment and balance, demanding that the information relative to sales, inventories, operating costs, and overheads be periodical, not intermittent, and so condensed as to be immediately indicative of the status of each part. The cost system, to serve its purpose, must be to the executive what the red flag is to the railroad—it must flash the danger sign where trouble is located and indicate when the going is safe. But few executives have the time or patience to thoroughly analyze a mass of figures. If they took the time or were blessed with the patience, they probably would be but poor executives. A simple plotted chart makes a fault stand out like the proverbial sore thumb, while figures hide it as the needle in the hay stack.

Jordan and Harris in their book "Cost Accounting" state, "Where cost accountants have risen to positions of large responsibility, it has been due far more to their vision and ability to 'put things across' than their knowledge merely of the technique of cost accounting," This statement impressed me forcibly, because some cost accountants do become so interested in the technique of their work that the results asked for are entirely overlooked. Permit me to repeat that the executive is not interested in technique. Stress the use of results and let the executive ask for the "Whys and wherefores" if he has the curiosity to do so. If the installation of a cost system is to "stick" it must particularly fit the business methods of the executive; the reports must be condensed, yet with further detail available; it must report periodically both current and accumulative results; it must be departmentized and

classified for definite objectives and it must be weighed against extreme variations.

Cost Accounting and the Organization

Fordham and Tingley in their book "Organization and Budgetary Control in Manufacturing" state: "Thorough examinations which have been made in a large number of industrial plants have disclosed the fact that the majority are what are termed 'one man organizations,' that is, one man dominating every division and exercising control over all. The great majority of executives work on the mistaken and egotistical principle that they are sufficient in themselves." The "one man organization" will never benefit from a cost system because it requires a thorough organization to realize benefit from it. Its purpose is to divide the business into distinctly separate units that each may be individually analyzed for results and it naturally follows that the responsibility for these results must be definitely placed on certain individuals.

Cost Accounting is a requisite to business organization, having to do with each of its functions—merchandising, operating, and financial—somewhat as a daily newspaper serves the public, to report periodically the status of each part of the business to the executive officers that they may judge from present conditions the necessary moves to make in preparation for the future. The argument, so often heard, that cost information reports but past history is offset when past experience is intelligently used to formulate plans for the future. Every intelligent executive knows the general trend of future business, both as to price conditions and sales volume and endeavors to meet these anticipated conditions with the wisdom obtained from past experience. If he has developed ratios and turnovers with the aid of cost accounting, he can definitely plan to meet future conditions with positive assurance that past experience will guide his moves with but a small chance for error.

Executive Confidence in Reports

Nothing more discourages the executive confidence in a cost report than widely varying returns on the same ratio within periods when no radical change in business conditions warrants a variation. Let this occur but once and the busy executive will immediately conclude that the report is wrong, cannot be relied upon and having lied once will continue to do so. Let us presume, for the purpose of illustration, that machine burden (which is a ratio) is recorded by dividing the machine expense per month by the total direct machine hours per month; that during one month an expensive machine was completely overhauled, causing a high machine burden; while next month practically no machine repairs were required, causing a low machine burden. Thus the two months show an extreme variation in machine burden rates. Neither month reflects information that is reliable or of any value. However, if this record is continually made, then over a yearly period the total expense divided by the total hours would reflect an average that truly represented average experience. Those ratios susceptible to considerable fluctuations must be budgeted at average and charged into costs at a constant rate. This serves the double purpose of weighing the burden rates and creating a standard of expense to strive for. The accounting to provide for this would require a reserve account which would be credited monthly with the amount budgeted and debited with the actual expense incurred. This account would indicate a constant profit or loss balance on burden applied.

Cost Accounting and Budgeting

A well known economist states, "You are already budgeting your business in a general way. You are making a sales budget when you say, 'Our sales during next year ought to be about $870,000.' You are making an inventory budget, when you add, 'In selling that amount, we need about $510,000 in raw materials.' And you are budgeting your payroll, when you conclude, 'To handle that production you will require a payroll of about $200,000.' The theory is simple. Business budgeting is merely estimating the income and expenditures of your business during the next year."

Budgeting can be done accurately only when the information from the cost system is carefully analyzed to show the trends of cost ratios in relation to the various volume levels of production or sales.

Cost as a Factor in Pricing

The objective of business is profit. Cost Accounting aids management in ascertaining profits made and in estimating profits desired. It would be difficult to conceive a more important influence toward good business management than this. But cost recording and figuring profits are two different problems. Cost

accounting is merely the reliable information upon which the charging of profit is in part determined. Actual costs do not determine the selling price.

The Gross Profit Method of Pricing

It is customary to add a gross profit to purchase or factory cost to determine a selling price. Were this gross profit currently recorded and applied in constant ratio to purchase or factory cost, then no great error would occur, but such is not the usual procedure. It has become usual practice for merchandisers to use a constant percentage of gross profit as indicative of average competitive standards and apply this percentage uniformly. The effect of this method may be ruinous. For instance, presume that 33-1/3% is the correct gross profit to add to a purchase or factory cost of $1.00 to make a sales price of $1.33. If, due to market changes or increased efficiency in the factory, the purchase or factory cost is reduced to 75c, then at a gross profit of 33-1/3% the selling price is $1.00. The change in the purchase or factory cost does not alter the cost of office and selling expense, yet the gross margin which included these expenses has been reduced from 33c to 25c. By using this method the manufacturer may become so efficient in his factory in lowering costs that he will "go broke."

Estimating Profit

The allowance for profit over cost must consider two objectives: (1) To earn sufficient profit to offset the fixed charges for the use and protection of capital; and (2) To obtain a reward for the value of service rendered. These two objectives have nothing in common.

Relation of Fixed Charges to Profit

The allowance for profit in the sales price to cover fixed charges is not an operating profit. Fixed charges are interest on the investment, insurance, taxes, and depreciation. Capital is entitled to a normal rate of interest and is invested in industry that it may earn more than a normal rate. Unless it does earn more, then the return cannot be considered an operating profit. Interest on the investment is included in estimated costs for the purpose of assuring a return equal to a normal interest rate on the money invested. The inclusion of charges for insurance, taxes, and depreciation in costs are quite similar in purpose to interest, in that these charges are included in estimated costs to cover deferred charges: insurance to protect, taxes to meet fixed obligations, and depreciation to sustain the investment at is original value.

The percentage used in costing to provide for these charges is determined by the turnover ratio of investment to sales. The percentages of interest on the investment, insurance, taxes, and depreciation, divided by the turnover ratio equals percentages which if charged into costs will return an amount equal to the total yearly fixed charges. It is of the utmost importance that the turnover of each commodity be determined separately, for if a blanket turnover is used, then competitors will sell those commodities on which the turnover is fast and let you sell where the turnover is slow. Where possible, commodities should be grouped into classifications that match competitors whose business includes only those commodities opposite each group. By applying only direct costs incurred and by equitably distributing indirect costs against each group, competitive effort is matched and the question as to advantage between specialized or departmentized business is determined by comparative economics.

Operating Profit

Operating profit is determined by the value of services rendered. Capital, management, and men are combined in industry to sell certain services and these services will be rewarded in accordance with the buyer's judgment of the value received. The amount of operating profit obtainable bears no relation to investment, turnover, or cost and may be considered in the same category as wages, salaries, or payment for medical service, in that the charge made is worth to the buyer the value of the service received. The market value of "Personal" service (a corporation is a person in a legal sense) is influenced by:

1. The earning value of the article to the buyer. For instance, a machine may cost $100 to make, but due to its production capacity, be worth $500 to the buyer. Here the personal service rendered by the engineers employed by the manufacturer enables the seller to obtain a large margin of operating profit over the fixed charges on the capital invested.

2. The reputation of the seller increasing the operating profit obtainable by creating a desire for a particular make of goods. This may occur through advertising, appreciated quality, or established confidence in the maker.

3. Proprietary or patent articles permitting of a wide margin of operating profit.

4. Efficient manufacturing or merchandising methods increasing the operating profit obtainable.

5. An efficient and courteous personnel, liberal credit arrangements, prompt service, a complete stock, or other advantages of capable management permitting of increased reward for personal service.

6. Mass production of similar articles and special work, made to order, carrying different margins of operating profits. When this condition exists, the possible profits of mass production must be computed and the slowing down of production volume caused by special work must be compensated for by added profit on the special work.

Many other influences exist that determine the amount obtainable for the value of "personal" services rendered, but these illustrations indicate the purpose in separating the allowance for profit into two classifications, one for creating an offset for fixed charges, and the other for the reward of personal services rendered.

Overheads and Ratios

The results obtained from a cost system depend upon the use made of the information it develops. It is very interesting to know that commercial burden is 20% of factory cost, but if the information is not used for a definite purpose, then the expense of obtaining it had better be saved. A cost system may be a work of art to be admired, or a working plan to be followed. Business men, as such, have no time to admire works of art, so it had better be a workable plan or out it goes.

Sales is the item of most importance in business. In designing a cost system, the first problem is to form a flow chart of each and every type of sales made. Every item of material, labor, and expense that enters into the cost of each kind of goods sold must be traced in sequence of operations from the purchasing of raw materials to the delivery of the finished article. Costs and overheads must be applied as and where they incur in the process of production and distribution if the total cost is to be compiled accurately. If costs and overheads are properly classified and applied in sequence of operation, then the cost of any kind of sale can be estimated, if it can be produced by the equipment and organization.

It would be useless for me to enter into the details of segregating overheads and costs. Every business has problems all its own in this respect and cost systems must be fitted to each business accordingly.

Where commodities are grouped into departments to match competitors, then overheads and costs must be likewise divided. No difficulty arises in charging direct costs to these departments but considerable ingenuity is required to equitably apportion general expenses. As a rule, the use of percentages should be avoided in apportioning general expenses and that kind of expense which cannot be measured accurately should be budgeted. Doing this will tend to level variations in departmental overheads and render the compilation of costs less subject to erratic fluctuations.

Financial and turnover ratios are evident in their purpose and space does not permit discussion of them here. Every executive needs these to control the efficient functioning of his organization.

Executive control of overheads and ratios should be maintained by the use of graphic charts and not entirely by means of figures. Charts indicate trends instantly, whereas figures require analysis. When a standard of efficiency has been ascertained for each overhead, or ratio, then a blue line should mark this level across the chart. This should be done at the beginning of each year, and it will be, in effect, a budget or a mark to "shoot at." Those men in the organization responsible for these overheads or ratios should receive the detailed costs included, and the results, good, bad or indifferent, should be discussed between the executive and those men for the purpose of planning future improvement. Overheads must be analyzed in conjunction with costs to determine relative efficiency. Overheads can go up while costs go down. In fact, where overheads are based on units or in ratio to other costs, they generally do go up. To illustrate this, let us presume that commercial burden (the cost of distributing) is $20 and the factory cost (the cost of producing) is $100, thus making commercial burden 20% of factory cost and the total cost $120. If the factory cost were reduced to $80, because of increased efficiency, then commercial burden (the cost of distributing would not change) would increase in ratio to 25% of factory cost and the total cost would decrease to $100.

The Cost System and Factory Production

It is extraordinary how few manufacturers connect cost finding with cost analysis and planned control. Cost-finding is a measuring device to ascertain the cost of completed operations, but it does not naturally follow that desire for improvement will cause the man-

(*Continued on page* 22)

The Crushed Stone Journal

Official Monthly Publication of the
NATIONAL CRUSHED STONE ASSOCIATION, INC.
Merchandise Building 1735 Fourteenth St., N. W.
WASHINGTON, D. C.

J. R. BOYD, Editor

Officers and Executive Committee — National Crushed Stone Association

OFFICERS

W. F. WISE, President
Southwest Stone Co., Dallas, Texas

F. T. GUCKER, Treasurer
John T. Dyer Quarry Co., Norristown, Pa.

J. R. BOYD, Secretary
Washington, D. C.

A. T. GOLDBECK, Director, Bureau of Engineering
Washington, D. C.

REGIONAL VICE-PRESIDENTS

C. M. Doolittle (Canadian) — Allen Patterson (Central)
Paul C. Graham (Western) — W. R. Sanborn (Northern)
Harry Landa (Southwestern) — T. I. Weston (Southern)
A. S. Lane (Eastern) — Porter W. Yett (Northwestern)

EXECUTIVE COMMITTEE

W. F. WISE, Chairman
W. M. Andrews — O. M. Graves
H. E. Bair — E. J. Krause
C. M. Doolittle — A. L. Worthen

Housekeeping to Prevent Accidents

ACCIDENTS cost money. The cost comes out of profits, or, if you put it on the selling price, the other fellow who keeps down his production costs by holding down accidents, has a good chance to take a nice contract away from you on price alone.

A big and obvious hazard always gets plenty of attention. Everybody sees it. Everybody thinks about it and soon all of this collective thinking brings out a real, and usually simple, answer to the problem. It's easy.

The less spectacular things, the "little hazards", usually do not get much attention. Let us take housekeeping for an example. That is a subject in which most people are not greatly interested, and rarely give thought to it and its importance.

There is nothing spectacular about it and there is very little "kick" to be had on a hot afternoon, in picking up rock which has fallen onto the runway or road from a badly loaded car or truck or conveyor belt, so that someone will not fall over it.

Instead of bringing it down with him, the tired carpenter leaves the plank that he has been standing on in the roof trusses, thinking he will use it again next week anyway. Meantime it falls down on some one. Or if it is still there, he turns it on edge to dump off the dust and grit, and the man down below gets an eyefull of dirt and loses an hour and a half going to the village to have the doctor take out the foreign particles.

The roofer leaves an empty nail keg or a board on the roof from which the wind blows it the next day, barely missing some one in the yard below.

A slovenly oiler has caused many a man to slip and fall on a greasy floor, and a bearing running hot has started many a fire because the surroundings had been permitted to become nicely oil-soaked by the same slovenly oiler.

It is so much easier to leave a bar lying whereever you happen to get through with it than to put it where it belongs or where it can not be tripped over or fall on some one.

The man to whom an upstanding nail means nothing, and the man who snags himself on the rim of a nail keg from which he has been too lazy to remove the nails or clinch them, deserves only jeers, but the company must pay just the same.

There is nothing about these "little hazards" to call special attention to them, or to interest anyone, but when you analyze your accident records you will be impressed with the fact that these "little hazards" account for a large part of all the "near accidents" and "lost time accidents" in American industry.

Accident hazards have been studied in all manner of ways. Every student of accident records and every worker in the cause, regardless of the industry in which he is particularly interested, quickly finds that good housekeeping—"a place for everything and every thing in its place"—is a fundamental of accident prevention. When housekeeping is poor accidents are bound to occur. When the housekeeping standards are high, one of the largest and most important causes of accidents is eliminated.

One of the most important factors of all is the bad effect of bad housekeeping on a man's habits of work, and correspondingly, the good effect on them of good housekeeping. If it's the fashion in a quarry, or plant,

or mill to be disorderly with things, the tendency is all toward being disorderly and careless with the work. Just as the careless and disorderly child is characterized by dropping hat and coat and overshoes wherever he happens to take them off, so is the careless workman characterized by leaving loose material around, and in not taking care of what he uses and has been entrusted with. The careless workman leaves the short end of the plank on the roof. He takes a pound of nails from the store-room, uses half of them, and leaves the remainder in a corner instead of returning them to the store room.

Bad housekeeping betokens a slovenly attitude of mind. Such an attitude makes for poor workmanship, accidents, and correspondingly higher costs. It is certainly safe to say that in few quarries is the standard of housekeeping a high one, and in many quarries it is deplorable.

Housekeeping includes many things, some of which it may apear on the surface have no bearing on accident prevention. Good housekeeping, however, has its effect in producing a state of mind towards orderliness as well as actually eliminating physical conditions which may cause accidents. In other words, good housekeeping training is a preventive of accidents as well as a cure. Get out the accident records; check them over for accidents or near accidents which were due to any one of the following factors.

Loose materials. Left in position to fall or be blown down by the wind from scaffolds, walkways, boilers, roofs. The removal of loose parts, tools and materials when work is completed will overcome this and the use of baskets or buckets for hoisting tools, parts, etc. will save dropping them on those below.

Passageways. Many cases of falls and stumbling are caused by leaving bars, rocks, and other loose objects in passageways which are frequently used, and around areas where men are constantly working.

Projecting nails. Accidents from nails projecting at the rims of barrels or kegs are inexcusable, as well as those resulting from stepping on a board with an upstanding nail. A feautre often overlooked, however, is caused by the construction department driving nails into side walls and timbers, and leaving them in such a position that some one passing by will be torn upon them. The same thing applies to the storage of sharp edged material adjacent to passageways.

Storage and piling of material. Where material or rock is to be piled, see that it is so placed that there is sufficient clearance between it and moving cars, and that it is properly braced so that it will not slide and fall on some one passing by.

Store ropes and chains on hooks or saddles, so that they will not only be kept up out of the way, but be kept in better condition.

Modern business is so complex with big problems that it behooves us to eliminate the little ones, so leaving our minds free for working on the large problems. Practically every housekeeping accident can be eliminated from any kind of plant. It is simply a matter of paying some attention to detail, by establishing a policy of clean housekeeping, and then following out the policy.

By eliminating the accidents resulting from these seemingly unimportant things, not only in housekeeping but in other subjects as well, it will be found that a very large part of the problem has been solved.

Directors Will Meet in Atlantic City

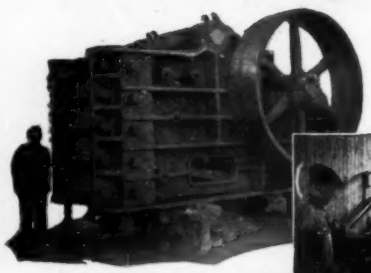
ON July 25 and 26 the Board of Directors of the Association will convene at the Ambassador Hotel, Atlantic City, for its semi-annual meeting in response to a call recently issued by President Wise. From all sections of the United States and from Canada your duly elected representatives will travel to Atlantic City, laying aside for the better part of a week their own important and personal interests, to devote two days exclusively to a consideration of the affairs of the Association. And gladly will they make the necessary sacrifices, both in time and expense, in order that the Association may advance and be better able to effectively and intelligently serve the industry which it represents.

One of the most important matters to come before the Board is the selection of the city and hotel for the Fourteenth Annual Convention of the Association to be held next January. It is no exaggeration to say that invitations so far received from practically every city of consequence in the United States and many in Canada are legion, and the Board will indeed have a difficult task in selecting the city and hotel which is to act as our host next January. Prominent among those from which the selection will probably be made are St. Louis, Pittsburgh, Memphis and Washington. Regardless of which city may be designated by the Board to entertain us, the industry can rest assured that the decision will be reached only after careful and detailed consideration is given the matter.

The *Soundest* specifications for jaw crushers and rolls

TISCO

Manganese Steel



The Buchanan Primary Crusher—jaw and cheek plates, and frequently the toggle bearings, are TISCO Manganese Steel.

The Buchanan Roll Crusher is also equipped with TISCO cheek plates—and frequently TISCO shells.

THE BUCHANAN CRUSHER—noted for long service and dependability—is regularly equipped with TISCO Manganese Steel jaw and cheek plates.

As with numerous manufacturers of all types of heavy duty equipment, this company has found that for dependability, wear-ability, and low operating cost, there is no sounder specification for wearing parts than TISCO Manganese Steel.

And this same dependability of TISCO Manganese Steel likewise appeals to far-sighted operators, *for all replacement parts.*

Special TISCO bulletins are available covering your requirements. Copies gladly sent on request.

TAYLOR-WHARTON IRON AND STEEL CO.

HIGH BRIDGE, NEW JERSEY

SALES OFFICES:

Boston Chicago Houston Los Angeles Montreal New York
Philadelphia Pittsburgh San Francisco Scranton Tampa

Costs As a Factor in Management

(*Continued from page* 19)

agement to devise ways and means to lower these costs. With the cost of each operation established, it should then be used as a record to better.

Intermittent test costs are unreliable. Unless the sum of individual operation costs, numerically recorded for a given period, computed at a standard direct labor rate, approximate the direct labor payroll for the same period, then proof of accuracy of the individual rates is not established.

A problem in handling labor is determining what a man or machine is capable of accomplishing. Recording what he or the machine does is a basis for analyzing his job or machine to determine what they can do. It is not a question of driving the man to work harder but rather to break up his habit of doing things in a certain way and to think how it can be done in a better way.

If honestly and fairly dealt with, workmen will cooperate with management in lowering costs. The first step in accomplishing this is permitting the foreman and men to know their production and cost records. A surprise is in store for the factory manager who has not asked for the assistance of his men in lowering costs. The Cost Department should periodically furnish the foreman with his department's production and cost records and thoroughly check them over with him.

Uniform Cost Systems

The market price of standard goods is strongly influenced by the least efficient competitor in that industry. This type will earn enough in good times to satisfy his creditors who have carried him over bad times; will always be reported as being on the verge of bankruptcy; but by some means unknown to good business men will carry on and continue to sell sufficiently below the right price to embarrass those who endeavor to conduct their businesses profitably.

Trade associations are doing a great work to combat this evil and perhaps their most important function is the installation and maintenance of uniform cost systems. By means of uniform cost finding methods, unfiorm costs of the industry are compiled which does much to level great variations in pricing caused by individual methods of price compilation.

Because of its flexibility, the traction member maintains a full gripping contact with uneven surfaces and exerts tremendous pulling power. There's nothing else like the LINN!

LINN DOES QUARRY HAULING EASILY AND PROFITABLY...

Laying its own road as it carries pay load, the LINN eliminates the cost and time lost in moving fixed tracks. It goes wherever the shovels are working and hauls out the loads in quick time and at economical cost. Up-grades do not halt it. Neither is it stopped by soft surfaces, mud or bad weather.

Its exclusive design, plus its great chassis strength . . . its giant power . . . and its ten-ton pay load capacity, make it the ideal hauling unit for quarry operations.

LINN'S roller chain assembly transfers the entire weight, distributing it evenly over the full area of the ground contact of its *patented flexible traction*. This assembly has no weight-carrying axles or axle-bearings and is free from destructive friction. The traction members, of 12% manganese steel, are non-clogging and non-slipping.

Performance facts and other information about the LINN in a variety of industries is available. Your letter will bring it promptly.

Patent No. 1,270,581
" " 1,521,454
" " 1,685,641
" " 1,685,676
" " 1,701,979
Other Patents Pending.

LINN MANUFACTURING CORPORATION

Division of LaFRANCE-REPUBLIC Corporation

Manufacturers of American La France Trucks, Linn Tractors, Republic Trucks

Factories: Alma, Mich. Morris, New York

Represented in:

New York City
Boston
Skowhegan, Maine
New Haven, Conn.
Baltimore
Charlotte, N. C.
Memphis, Tenn.
Johnson City, Tenn.
Philadelphia
Pittsburgh
Louisville, Ky.
Detroit
Chicago
St. Louis
Kansas City, Mo.
Little Rock, Ark.
Tulsa, Okla.
Omaha, Nebr.
Sioux Falls, S. D.
St. Paul, Minn.
Salt Lake City
Denver
Jerome, Ariz.
Los Angeles
San Francisco
Portland, Ore.
Spokane

105 direct distributors located throughout the United States and 49 distributors located in 30 foreign countries

Canadian Linn Distributors: Mussens' Limited, Montreal

When writing advertisers please mention THE CRUSHED STONE JOURNAL

THEW LORAIN 75

HEAVY-DUTY QUARRY SHOVEL

THEW SHOVEL COMPANY • Lorain, Ohio

¾ to 1¼ and 1½ yd. Shovels, Clamshells, Draglines

Electric, Gas, Diesel Powered

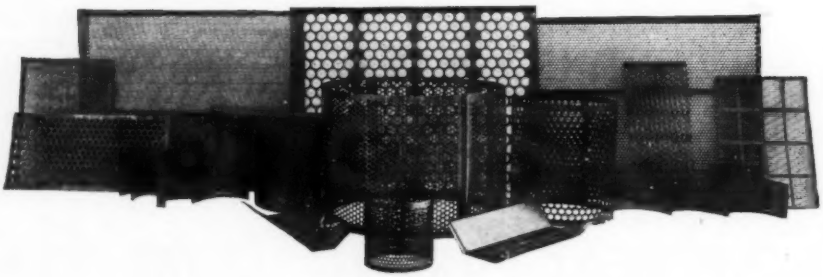
FLEXCO
HD Belt Fasteners
These well known fasteners stop trouble with elevator and tight butt conveyor joints. They have far more strength than needed and the pull is equalized on both sides of the belt insuring long service. Note recessed plates which embed in and compress the belt instead of pulling against the bolt holes. Stocked by leading jobbers in 5 sizes. Consultation invited.
Flexible Steel Lacing Company
4625 Lexington Street Chicago, Illinois
Recommended by leading belting manufacturers
for Conveyor Belts

PERFORATED METAL SCREENS

The quality of CROSS Screens gives longer service, increased production and lower cost.

CATALOG ON REQUEST.

BUCKETS, TROUGH, FLIGHTS, CHUTES, ETC.

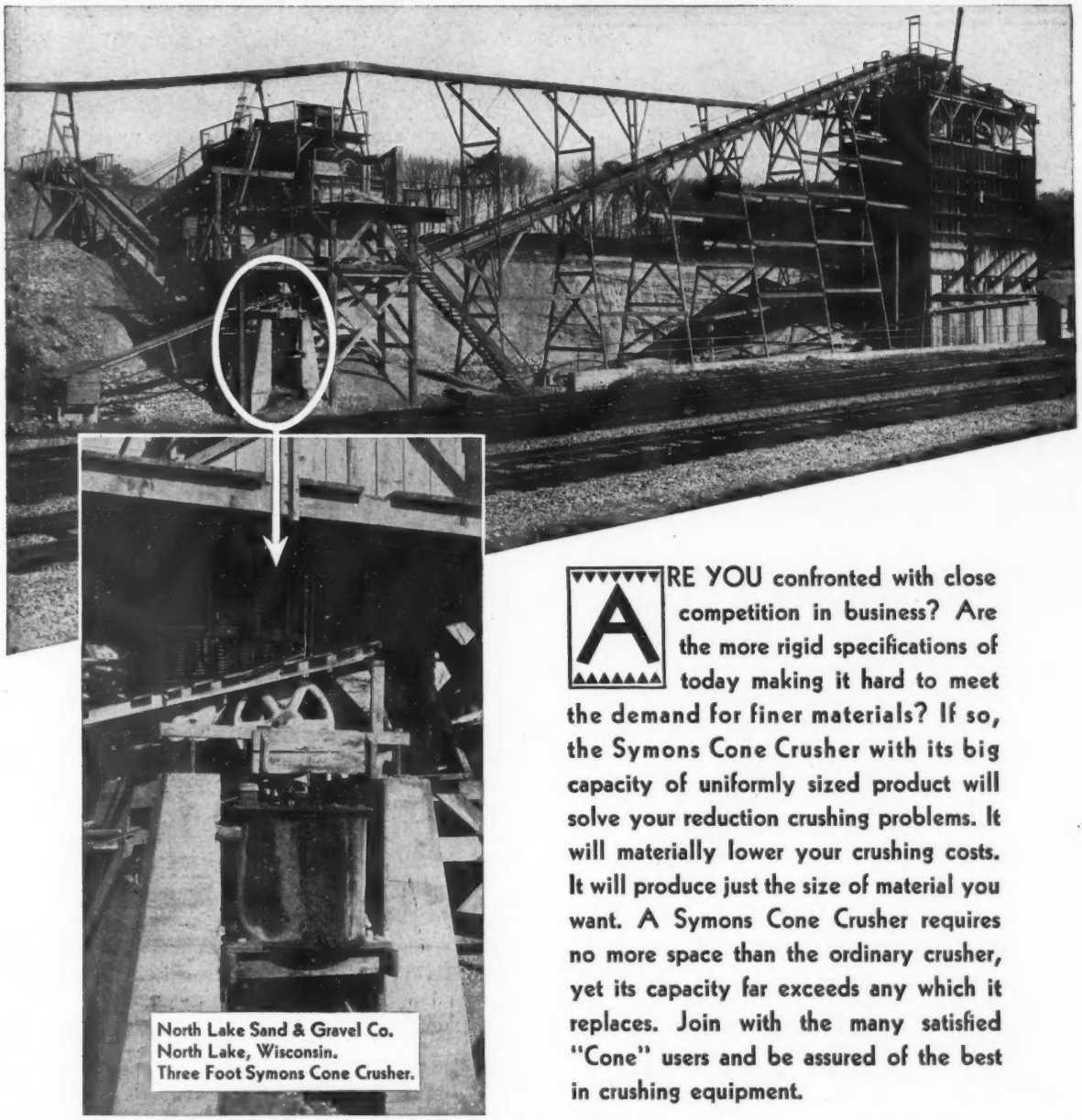


Rush Orders often Shipped within twenty-four hours

CROSS ENGINEERING CO.

CARBONDALE, PA.

THE CRUSHER THAT SERVES YOU BEST



North Lake Sand & Gravel Co.
North Lake, Wisconsin.
Three Foot Symons Cone Crusher.

ARE YOU confronted with close competition in business? Are the more rigid specifications of today making it hard to meet the demand for finer materials? If so, the Symons Cone Crusher with its big capacity of uniformly sized product will solve your reduction crushing problems. It will materially lower your crushing costs. It will produce just the size of material you want. A Symons Cone Crusher requires no more space than the ordinary crusher, yet its capacity far exceeds any which it replaces. Join with the many satisfied "Cone" users and be assured of the best in crushing equipment.

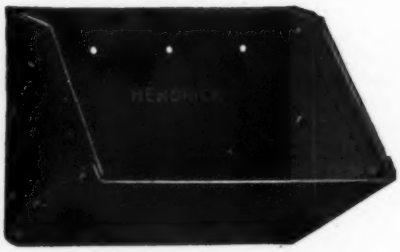
NORDBERG MFG. CO. MILWAUKEE, WISCONSIN

NEW YORK CITY
51 East 42nd St.

LONDON, W. C. 2
Bush House

LOS ANGELES, CALIF.
1462 Stanley Ave.

SYMONS CONE CRUSHER



Why Many Producers Use Hendrick Buckets

THEY prefer Hendrick Elevator Buckets because they have found through experience that the service given keeps pace with their other high grade equipment.

They have found that even on such wearing equipment as buckets, it pays to buy quality equipment.

The suggestion is made that you try Hendrick Buckets in your plant.

HENDRICK MFG. CO.

39 River St., Carbondale, Pa.

New York Office: 30 Church St.
Pittsburgh Office: Koppers Building
Hazleton, Pa. Office:
533 Lincoln St.

Makers of Mitco Interlocked Steel Grating,
Mitco Shur-Site Treads and Mitco Armorgrids
Hendrick Perforated Metal Screens

Business Tries Common-Sense

(*Continued from page* 15)

actual effect is unreasonably to restrain full and fair competition in any such trade or business.

If trade associations overstep the prescribed bounds and attempt surreptitiously to engage in these or similar malpractices, they cannot justly complain if they find themselves the objects of active interest on the part of the Federal Trade Commission or the Department of Justice. Laws for the protection of the public were placed on the statute-books to be enforced; transgression carries penalties.

Any association that enters such evil paths is faithless to the cardinal conception of the great trade-association movement, which envisions the relentless rooting out of commercial injustice and clandestine knavery.

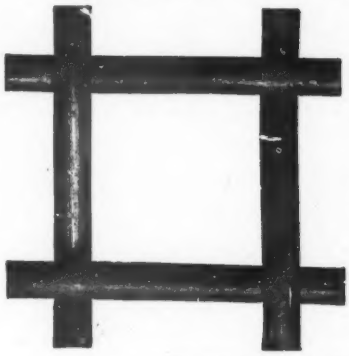
Associations Should Assist Retailer

In what manner may trade associations to-day extend their activities legitimately with greatest benefit to business life? There is at least one channel that would seem to afford a rare opportunity for valuable constructive effort. I believe that trade associations should set zealously to work in an endeavor to improve the situation of the frequently distressed and harried retailer. Countless thousands of such retailers have had no contact with the benefits that are derivable from trade-association activity. And their condition, in some respects, has brought on other infirmities in the body of our business. It behooves the associations, in coöperation with banking and other interests that have direct relations with the retailing community, to further such remedial measures as seen best suited to alleviate an unquestionably disquieting situation. What those measures are to be should be determined by careful study.

Speaking of trade associations at a time when he was still Secretary of Commerce, Mr. Hoover said: "They are the safeguards of small business and thus prevent the extinction of competition. They are the alternative to capital consolidation. The underlying purposes of the vast majority are constructive." And, referring to the broad impulses which find expression in such bodies, he added with conviction: "With wisdom and devotion these voluntary forces can accomplish more for our country than any spread of the hand of government."

ROK-TEX

FROM 50% TO 200% LONGER LIFE



In many progressive stone crushing plants, ROK-TEX is the accepted standard for all stone and rock screening purposes. It's especially built to resist the strains and abrasive action of stone screening.

Actual experience has proven that "Buffalo" ROK-TEX Wire Cloth has from *50% to 200% longer life* than ordinary wire screening. Every precaution is taken in the manufacture of ROK-TEX to insure *extra*-durability and *longer* life. It's woven from special analysis steel on improved power looms. Galvanized after weaving for added strength and to assist in preventing corrosion.

It will be profitable to you to follow the example set by other progressive stone crushing plants when you place your next order. ROK-TEX is made in all standard sizes.

A letter to us stating your needs will bring full information, samples and prices.

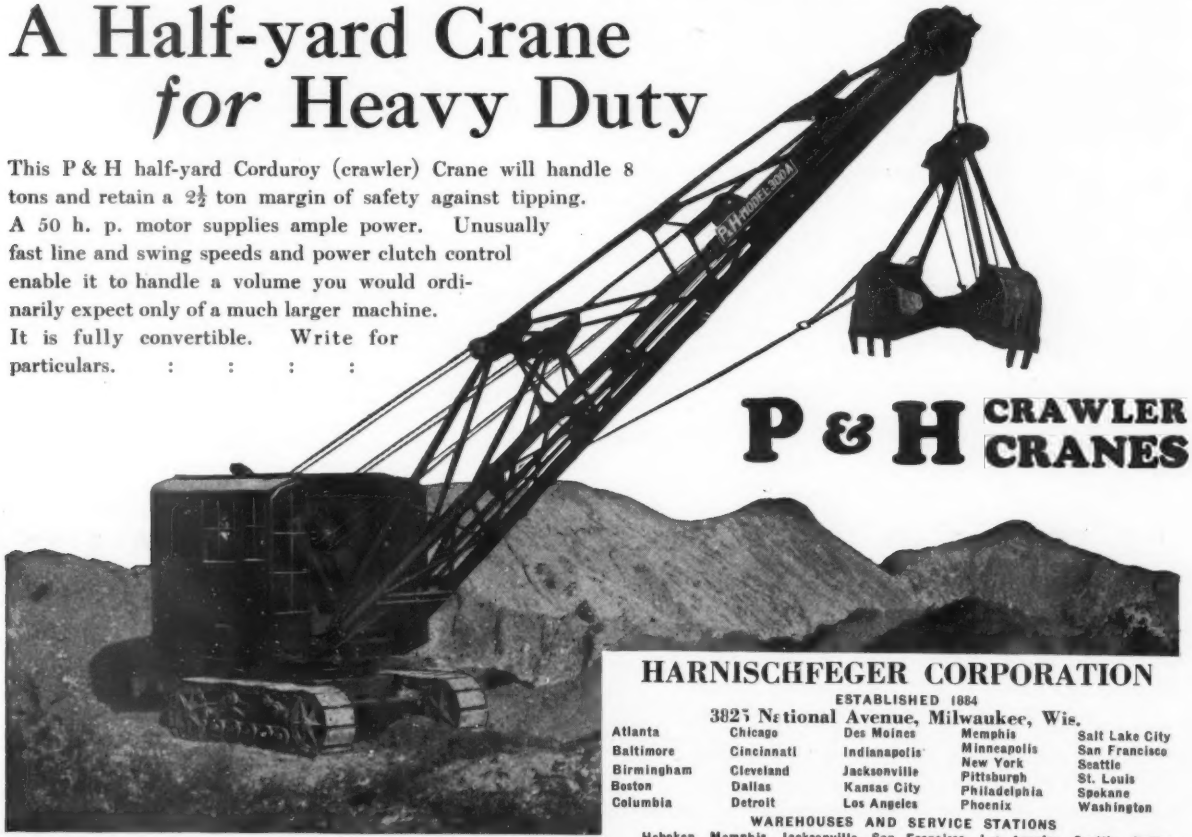
BUFFALO WIRE WORKS CO., Inc.

(Formerly Scheeler's Sons. Est. 1869)

585 TERRACE, BUFFALO, N. Y.

A Half-yard Crane *for* Heavy Duty

This P & H half-yard Corduroy (crawler) Crane will handle 8 tons and retain a 2½ ton margin of safety against tipping. A 50 h. p. motor supplies ample power. Unusually fast line and swing speeds and power clutch control enable it to handle a volume you would ordinarily expect only of a much larger machine. It is fully convertible. Write for particulars. : : : :



P & H CRAWLER CRANES

HARNISCHFEGER CORPORATION

ESTABLISHED 1884

3823 National Avenue, Milwaukee, Wis.

Atlanta	Chicago	Des Moines	Memphis	Salt Lake City
Baltimore	Cincinnati	Indianapolis	Minneapolis	San Francisco
Birmingham	Cleveland	Jacksonville	New York	Seattle
Boston	Dallas	Kansas City	Pittsburgh	St. Louis
Columbia	Detroit	Los Angeles	Philadelphia	Spokane
			Phoenix	Washington

WAREHOUSES AND SERVICE STATIONS

Hoboken, Memphis, Jacksonville, San Francisco, Los Angeles, Seattle, Dallas

ATLAS BLASTING MACHINE

1 to 50 SHOT CAPACITY

THE purpose of a Blasting Machine is to convert muscular energy into electrical power that may be used to fire a series of Electric Blasting Caps . . . . . Ten years' experience has assured us that the fundamentals of design of the Atlas No. 3 Blasting Machine are correct. Refinements in design have been made from time to time, thereby increasing the efficiency and durability of this machine, but no radical changes have been made.

As a general rule, factors other than the capacity of the blasting machine limit the number of Electric Blasting Caps that may be successfully fired in series. Under ideal conditions, which seldom ever exist in the field, the Atlas No. 3 Blasting Machine has consistently fired one hundred and fifty Atlas 30-ft. Copper Wire Electric Blasting Caps in a single series. However, we prefer to be conservative and rate this machine at fifty Electric Blasting Caps of the same character wire and length in single series.

Larger, heavier, and more expensive blasting machines can be designed than the Atlas No. 3, but we are satisfied, through the experience we have gained, that a more durable and a more dependable machine than the Atlas No. 3 cannot be obtained.

ATLAS POWDER COMPANY

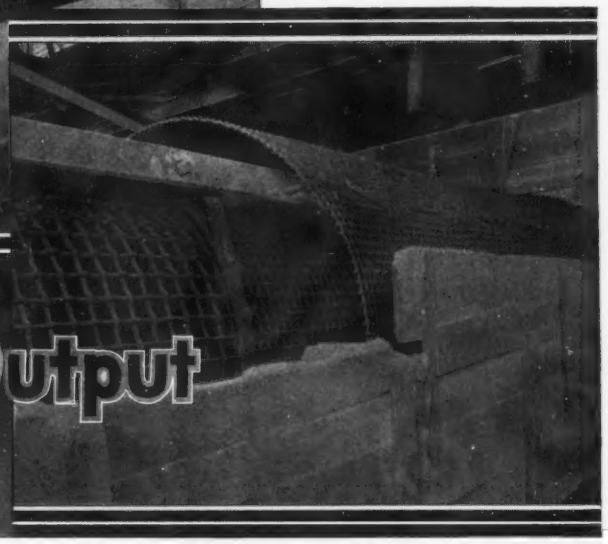
WILMINGTON, DELAWARE

Branch Offices:
Allentown, Pa.; Boston, Mass.; Charleston, W.Va.; Chicago, Ill.; Houghton, Mich.; Joplin, Mo.; Kansas City, Mo.; Knoxville, Tenn.; McAlester, Okla.; New Orleans, La.; New York, N.Y.; Norristown, Pa.; Philadelphia, Pa.; Pittsburg, Kansas; Pittsburgh, Pa.; Pottsville, Pa.; St. Louis, Mo.; Wilkes-Barre, Pa.

ATLAS EXPLOSIVES

When this battery of eight revolving screens was equipped with ROL-MAN instead of plate, the output of concrete stone was doubled.

Below is a close-up of one of the screens and shows how little the ROL-MAN Managanese Steel Screen sections have been affected by two years of service.



Doubling the Output *with* ROL-MAN

If you are concerned with screening operations, you will be interested in the experience of one of the largest and most successful crushed stone producing companies in the Middle West (name on request).

The eight large revolving screens shown in the upper illustration originally were equipped with ordinary plate having 1¼-inch round openings. They produced a size of stone for which there was a very large sale, but there was so much carry-over that it was impossible to get a sufficient output to satisfy the market demand for this size. There was sufficient crushing and conveyiny capacity; the screens simply were not delivering, and there was no room for additional units.

With this condition to face, a ROL-MAN Engineer was consulted. He recommended replacing the plate jackets with ROL-MAN Manganese Steel Screen sections having 1⅛ inch square openings, and four of the jackets were replaced during the winter of 1927. Three days after the next operating season was started and order was placed for ROL-MAN screens to equip the four remaining jackets.

Why? As explained by the plant superintendent, "Because we are now getting two carloads of concrete stone with ROL-MAN where before we only got one with the plate. And it's a much cleaner, more acceptable stone, too."

After this result, needless to say the company quickly began to replace plate with ROL-MAN in the main barrels of the revolving equipment. They have been in use two seasons and show little sign of wear.

Profit by the experience of others. Complete information and prices on ROL-MAN will be sent promptly on recipt of your inquiry.

ROL-MAN DOUBLE LOCK MESH WOVEN MANGANESE STEEL SCREENS

MANGANESE STEEL FORGE COMPANY

Manufacturers of

ROL-MAN ROLLED *and* FORGED MANGANESE STEEL PRODUCTS

Richmond Street and Erie Avenue, Philadelphia, Pa.

NEW YORK	PITTSBURGH	DETROIT	CHICAGO	LOS ANGELES
30 Church St.	Clark Bldg.	Lexington Bldg.	Builders Bldg.	320 S. San Pedro St.

When Falling Rocks *Crash!*

ENORMOUS shocks are encountered in every digging job. 50 years of experience has proved that the three-part hitch is the most effective hoisting arrangement. Three-part hitch permits better ratio of rope to sheave diameters, prevents damaging vibration on the machinery, reduces shutdowns of the shovel, results in longer service from cables and SAVES YOU MONEY.

Come To Shovel Headquarters

EVERYWHERE RELIABLE MARION SINCE 1884

THE MARION STEAM SHOVEL COMPANY

Shovels, Draglines, Cranes, 1 yd. to 20 yds.

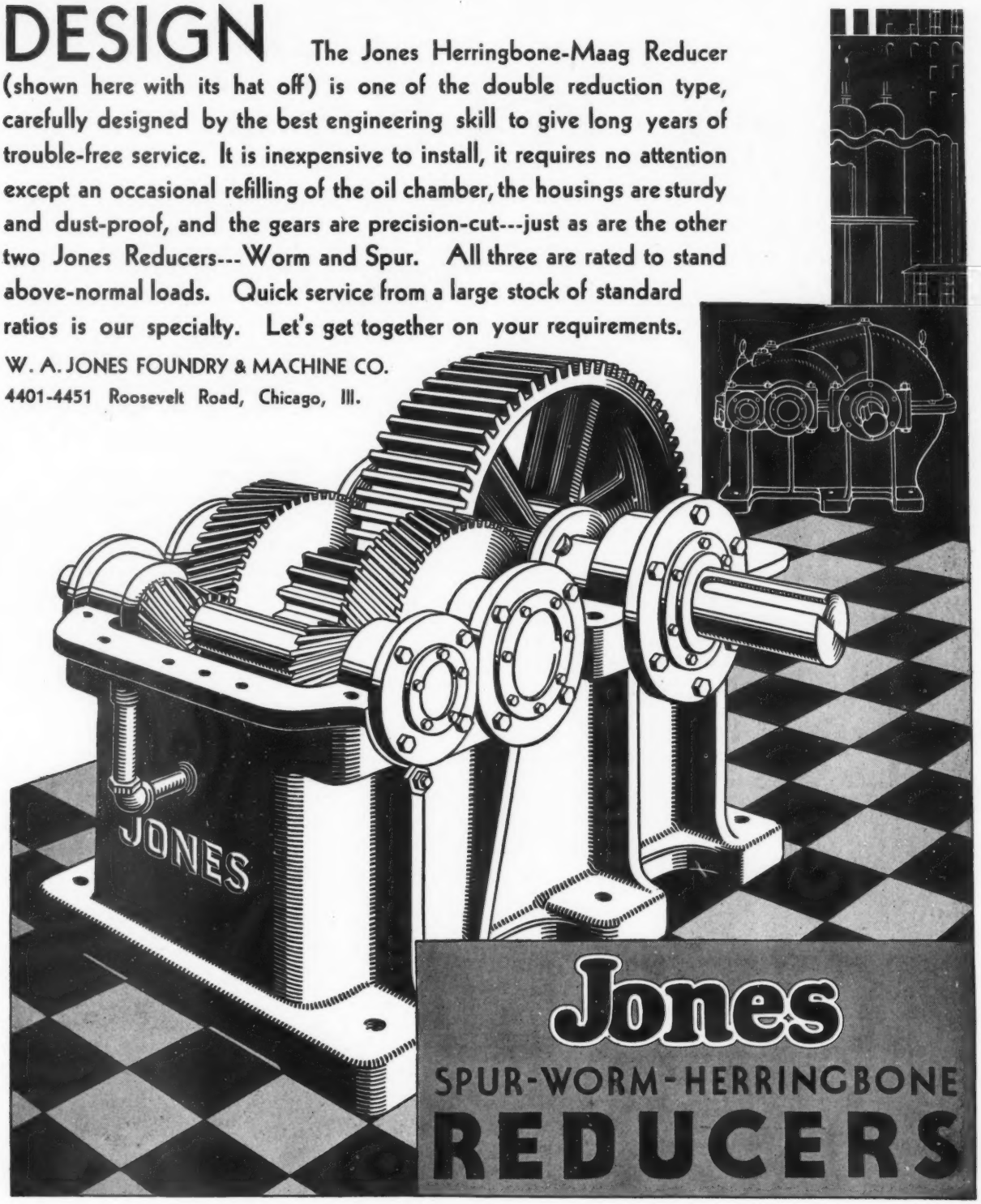
MARION, OHIO, U.S.A.

Representatives in the Principal Cities of the World

DESIGN

The Jones Herringbone-Maag Reducer (shown here with its hat off) is one of the double reduction type, carefully designed by the best engineering skill to give long years of trouble-free service. It is inexpensive to install, it requires no attention except an occasional refilling of the oil chamber, the housings are sturdy and dust-proof, and the gears are precision-cut---just as are the other two Jones Reducers---Worm and Spur. All three are rated to stand above-normal loads. Quick service from a large stock of standard ratios is our specialty. Let's get together on your requirements.

W. A. JONES FOUNDRY & MACHINE CO.
4401-4451 Roosevelt Road, Chicago, Ill.



» CHIPS «

WASTE

The editor of a newspaper wheeled his chair around and pressed a button on his desk. The office boy entered.

"Here," said the editor, "are a number of directions from outsiders telling us how to run our paper. See that every one is carried out."

And the office boy, gathering them all in a large waste basket did so.—*Regina Leader.*

FOOLING PAPA

Little Boy (calling father at office): "Hello, who is this?"

Father (recognizing son's voice): "The smartest man in the world."

Little Boy: "Pardon me, I got the wrong number."

—*Portland Adv. Spotlight*

The nation is so organized now that if you miss an evening of Amos 'n' Andy you hear most of it anyway in the course of the next twenty-four hours.

—*Detroit News*

Take a rubber snake along when you go out to play golf, and if you have trouble getting out of a sand trap you can hold the snake up and holler to the other players that you finally killed it.

—*Burkhardt Magazine*

Willie—"Say, Pa, didn't Edison make the first talking machine?"

Pa—"No, my son. God made the first one, but Edison made the first one that could be shut off."

—*Ad Printer*

Politician: "Congratulate me, dear, I got the nomination."

His Wife: "Honestly!"

Politician: "Why bring that up."

—*Hardware Age*

If Prohibition is repealed, Ford is going to quit making cars. If it isn't, Mack is going to make bigger trucks.—*Judge.*

The Accused—"I was not going forty miles an hour—not twenty—not even ten—in fact, when the officer came up I was almost at a standstill."

The Judge—"I must stop this or you will be backing into something. Forty shillings."

—*Tatler* (London)

And then there's the one about the Scotchman who sat up all night watching his wife's vanishing cream.

FIGHTING MOTHER EARTH

Broker—"I put a friend of mine on his feet three times in the last five years."

Jones—"Oh, that's nothing! I put a friend of mine on his feet fourteen times last night."

—*New Bedford Standard.*

A backwoodsman one day found a mirror which a tourist had lost. "Well, if it ain't my old dad," he said as he looked in the mirror, "I never knew he had his pitcher took."

He took the mirror home, stole into the attic to hide it, but his actions did not escape his suspicious wife. That night, while he slept, she slipped up to the attic, and found the mirror. "Hm-m," she said, looking into it. "So that's the old hag he's been chasin'."

—*The Dravo Bulletin.*

A colored man and his sweetheart, followed by three picaninnies, applied to the clerk of a Southern courthouse for a license to wed.

The clerk eyed the assemblage doubtfully.

"Whose children are these?" he asked.

"Dey our'n," was the ready response from the man.

The clerk was scandalized, being new at his post.

"You ought to be ashamed of yourselves, waiting to get married till you have a family half grown."

"Jedge, you'll have to excuse dat," interrupted the "bride" sweetly. "De roads out our way is so bad!"

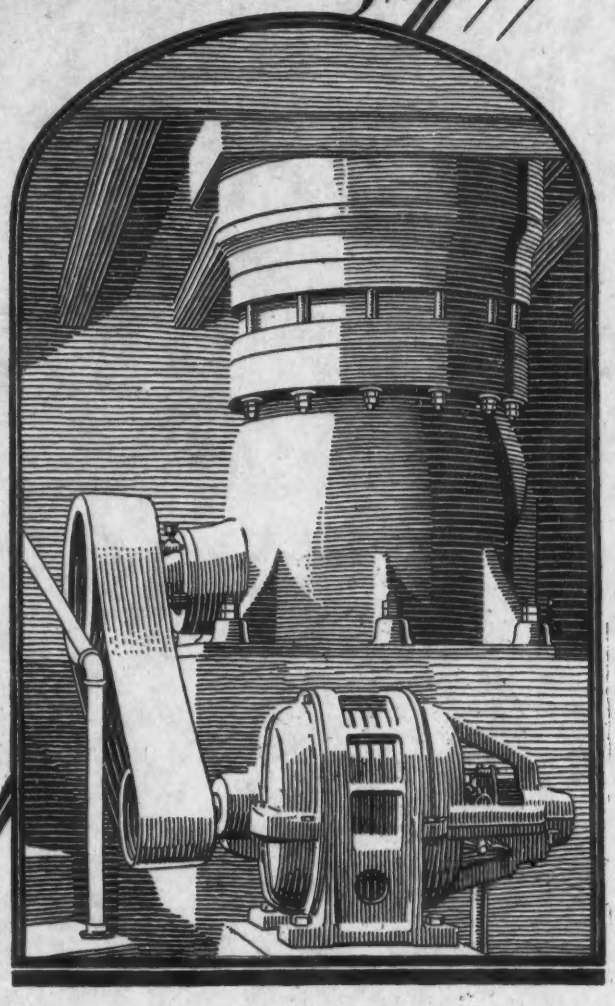
Meeting Every Power Need of the Crushed Stone Industry

For the new stone-crushing plants of 1930, and for the rebuilt old plants, too, specify G-E Motorized Power.

It is the power system that is designed to deliver the highest material output for the lowest kw-hr. input—the first requisite for low-cost production.

For plants of every size, G-E Motorized Power means the correct motor for each specific task; the control which will get the most out of the motor and machine with safety; and the correct application and co-ordination of motors and control for efficiency and economy.

The trend is toward G-E Motorized Power in the crushed-stone industry. In 1930, consult with G-E engineers on your needs. They are always ready to give you the benefit of their unexcelled facilities, wide experience, and advanced knowledge.



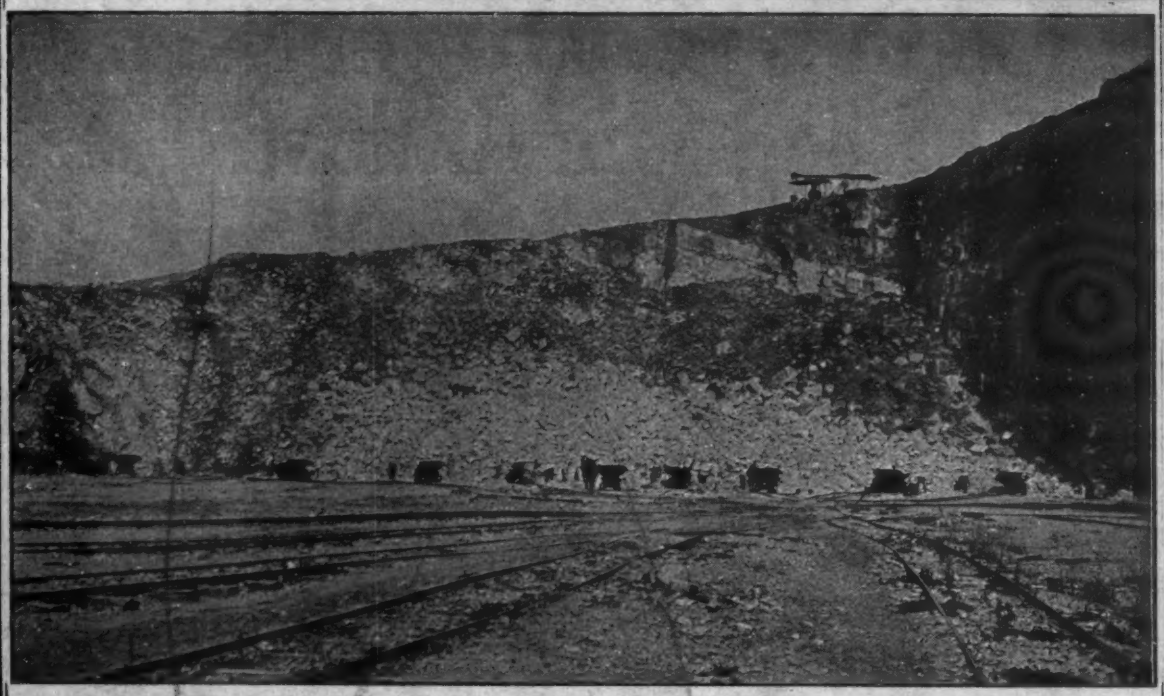
Apply the proper G-E motor and the correct G-E controller to a specific task, following the recommendations of G-E specialists in electric drive, and you have G-E Motorized Power. Built in or otherwise connected to all types of industrial machines, G-E Motorized Power provides lasting assurance of performance that builds confidence.

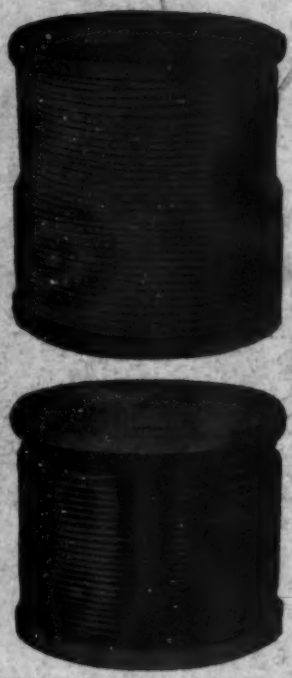
Motorized Power
—fitted to every need

200-225

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES





CORDEAU Helps Improve the Fragmentation

CORDEAU, by speeding up the rate of detonation of the explosive charges in a blast, adds materially to the shattering effect of the explosive no matter whether it is a high grade dynamite or the slower blasting powders. Rock well broken, toe kicked out, little secondary blasting, and crushing units well supplied with rock mean good operating conditions and consequent profit for the quarry operator.

CORDEAU
DETONATING FUSE
BICKFORD

THE ENSIGN-BICKFORD CO.

SIMSBURY - CONNECTICUT